TOSHIBA

Carrier

FILE NO. A09-010

SERVICE MANUAL

AIR-CONDITIONER
SPLIT TYPE

OUTDOOR UNIT

<SUPER DIGITAL INVERTER>

RAV-SP180AT2-UL (2 HP)
RAV-SP240AT2-UL (3 HP)
RAV-SP300AT2-UL (4 HP)
RAV-SP360AT2-UL (4, 5 HP)
RAV-SP420AT2-UL (5 HP)

PRINTED IN JAPAN, Dec., 2009 ToMo

Adoption of New Refrigerant

This Air Conditioner is a new type which adopts a new refrigerant HFC (R410A) instead of the conventional refrigerant R22 in order to prevent destruction of the ozone layer.

WARNING

Cleaning of the air filter and other parts of the air filter involves dangerous work in high places, so be sure to have a service person do it. Do not attempt it yourself.

The cleaning diagram for the air filter is there for the service person, and not for the customer.

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SAFETY CAUTION

The important contents concerned to the safety are described on the product itself and on this Service Manual.

Please read this Service Manual after understanding the described items thoroughly in the following contents (Indications/Illustrated marks), and keep them.

[Explanation of indications]

Indication	Explanation
⚠ DANGER	Indicates contents assumed that an imminent danger causing a death or serious injury of the repair engineers and the third parties when an incorrect work has been executed.
⚠ WARNING	Indicates possibilities assumed that a danger causing a death or serious injury of the repair engineers, the third parties, and the users due to troubles of the product after work when an incorrect work has been executed.
⚠ CAUTION	Indicates contents assumed that an injury or property damage (∗) may be caused on the repair engineers, the third parties, and the users due to troubles of the product after work when an incorrect work has been executed.

∗ Property damage : Enlarged damage concerned to property, furniture, and domestic animal/pet

[Explanation of illustrated marks]

Mark	Explanation
	Indicates prohibited items (Forbidden items to do) The sentences near an illustrated mark describe the concrete prohibited contents.
	Indicates mandatory items (Compulsory items to do) The sentences near an illustrated mark describe the concrete mandatory contents.
	Indicates cautions (Including danger/warning) The sentences or illustration near or in an illustrated mark describe the concrete cautious contents.

[Confirmation of warning label on the main unit]

Confirm that labels are indicated on the specified positions
(Refer to the Parts disassembly diagram (Outdoor unit).)

If removing the label during parts replace, stick it as the original.

⚠ DANGER	
 Turn off breaker.	**Turn "OFF" the breaker before removing the front panel and cabinet, otherwise an electric shock is caused by high voltage resulted in a death or injury.** During operation, a high voltage with 400V or higher of circuit (∗) at secondary circuit of the high-voltage transformer is applied. If touching a high voltage with the naked hands or body, an electric shock is caused even if using an electric insulator. ∗ : For details, refer to the electric wiring diagram.
 Execute discharge between terminals.	**When removing the front panel or cabinet, execute short-circuit and discharge between high-voltage capacitor terminals.** If discharge is not executed, an electric shock is caused by high voltage resulted in a death or injury. After turning off the breaker, high voltage also keeps to apply to the high-voltage capacitor.
 Prohibition	**Do not turn on the breaker under condition that the front panel and cabinet are removed.** An electric shock is caused by high voltage resulted in a death or injury.

⚠ WARNING	
Check earth wires.	**Before troubleshooting or repair work, check the earth wire is connected to the earth terminals of the main unit, otherwise an electric shock is caused when a leak occurs.** If the earth wire is not correctly connected, contact an electric engineer for rework.
Prohibition of modification.	**Do not modify the products.** Do not also disassemble or modify the parts. It may cause a fire, electric shock or injury.
Use specified parts.	**For spare parts, use those specified (∗).** If unspecified parts are used, a fire or electric shock may be caused. ∗: For details, refer to the parts list.
Do not bring a child close to the equipment.	**Before troubleshooting or repair work, do not bring a third party (a child, etc.) except the repair engineers close to the equipment.** It causes an injury with tools or disassembled parts. Please inform the users so that the third party (a child, etc.) does not approach the equipment.
Insulating measures	**Connect the cut-off lead wires with crimp contact, etc, put the closed end side upward and then apply a water-cut method, otherwise a leak or production of fire is caused at the users' side.**
No fire	**When repairing the refrigerating cycle, take the following measures.** 1) Be attentive to fire around the cycle. When using a gas stove, etc, be sure to put out fire before work; otherwise the oil mixed with refrigerant gas may catch fire. 2) Do not use a welder in the closed room. When using it without ventilation, carbon monoxide poisoning may be caused. 3) Do not bring inflammables close to the refrigerant cycle, otherwise fire of the welder may catch the inflammables.
Refrigerant	**Check the used refrigerant name and use tools and materials of the parts which match with it.** For the products which use R410A refrigerant, the refrigerant name is indicated at a position on the outdoor unit where is easy to see. To prevent miss-charging, the route of the service port is changed from one of the former R22. **For an air conditioner which uses R410A, never use other refrigerant than R410A. For an air conditioner which uses other refrigerant (R22, etc.), never use R410A.** If different types of refrigerant are mixed, abnormal high pressure generates in the refrigerating cycle and an injury due to breakage may be caused. **Do not charge refrigerant additionally.** If charging refrigerant additionally when refrigerant gas leaks, the refrigerant composition in the refrigerating cycle changes resulted in change of air conditioner characteristics or refrigerant over the specified standard amount is charged and an abnormal high pressure is applied to the inside of the refrigerating cycle resulted in cause of breakage or injury. Therefore if the refrigerant gas leaks, recover the refrigerant in the air conditioner, execute vacuuming, and then newly recharge the specified amount of liquid refrigerant. In this time, never charge the refrigerant over the specified amount. **When recharging the refrigerant in the refrigerating cycle, do not mix the refrigerant or air other than R410A into the specified refrigerant.** If air or others is mixed with the refrigerant, abnormal high pressure generates in the refrigerating cycle resulted in cause of injury due to breakage. **After installation work, check the refrigerant gas does not leak.** If the refrigerant gas leaks in the room, poisonous gas generates when gas touches to fire such as fan heater, stove or cocking stove though the refrigerant gas itself is innocuous. **Never recover the refrigerant into the outdoor unit.** When the equipment is moved or repaired, be sure to recover the refrigerant with recovering device. The refrigerant cannot be recovered in the outdoor unit; otherwise a serious accident such as breakage or injury is caused.
Assembly/Cabling	**After repair work, surely assemble the disassembled parts, and connect and lead the removed wires as before. Perform the work so that the cabinet or panel does not catch the inner wires.** If incorrect assembly or incorrect wire connection was done, a disaster such as a leak or fire is caused at user's side.

⚠ WARNING	
 Insulator check	**After the work has finished, be sure to use an insulation tester set (500V Megger) to check the resistance is 2MΩ or more between the charge section and the non-charge metal section (Earth position).** If the resistance value is low, a disaster such as a leak or electric shock is caused at user's side.
 Ventilation	**When the refrigerant gas leaks during work, execute ventilation.** If the refrigerant gas touches to a fire, poisonous gas generates. A case of leakage of the refrigerant and the closed room full with gas is dangerous because a shortage of oxygen occurs. Be sure to execute ventilation.
 Be attentive to electric shock	**When checking the circuit inevitably under condition of the power-ON, use rubber gloves and others not to touch to the charging section.** If touching to the charging section, an electric shock may be caused.
 Compulsion	**When the refrigerant gas leaks, find up the leaked position and repair it surely.** If the leaked position cannot be found up and the repair work is interrupted, pump-down and tighten the service valve, otherwise the refrigerant gas may leak into the room. The poisonous gas generates when gas touches to fire such as fan heater, stove or cocking stove though the refrigerant gas itself is innocuous. **When installing equipment which includes a large amount of charged refrigerant such as a multi air conditioner in a sub-room, it is necessary that the density does not the limit even if the refrigerant leaks.** If the refrigerant leaks and exceeds the limit density, an accident of shortage of oxygen is caused. **For the installation/moving/reinstallation work, follow to the Installation Manual.** If an incorrect installation is done, a trouble of the refrigerating cycle, water leak, electric shock or fire is caused.
 Check after repair	**After repair work has finished, check there is no trouble.** If check is not executed, a fire, electric shock or injury may be caused. For a check, turn off the power breaker.
 Check after reinstallation	**After repair work (installation of front panel and cabinet) has finished, execute a test run to check there is no generation of smoke or abnormal sound.** If check is not executed, a fire or an electric shock is caused. Before test run, install the front panel and cabinet.
	Check the following items after reinstallation. 1) The earth wire is correctly connected. 2) The power cord is not caught in the product. 3) There is no inclination or unsteadiness and the installation is stable. If check is not executed, a fire, an electric shock or an injury is caused.

⚠ CAUTION	
 Put on gloves	**Be sure to put on the gloves (*) and a long sleeved shirt: otherwise an injury may be caused with the parts, etc.** (*) Heavy gloves such as work gloves
 Cooling check	**When the power was turned on, start to work after the equipment has been sufficiently cooled.** As temperature of the compressor pipes and others became high due to cooling/heating operation, a burn may be caused.

• New Refrigerant (R410A)

This air conditioner adopts a new HFC type refrigerant (R410A) which does not deplete the ozone layer.

1. Safety Caution Concerned to New Refrigerant

The pressure of R410A is high 1.6 times of that of the former refrigerant (R22).

Accompanied with change of refrigerant, the refrigerating oil has been also changed.

Therefore, be sure that water, dust, the former refrigerant or the former refrigerating oil is not mixed into the refrigerating cycle of the air conditioner with new refrigerant during installation work or service work.

If an incorrect work or incorrect service is performed, there is a possibility to cause a serious accident.

Use the tools and materials exclusive to R410A to purpose a safe work.

2. Cautions on Installation/Service

1) Do not mix the other refrigerant or refrigerating oil.

   For the tools exclusive to R410A, shapes of all the joints including the service port differ from those of the former refrigerant in order to prevent mixture of them.

2) As the use pressure of the new refrigerant is high, use material thickness of the pipe and tools which are specified for R410A.

3) In the installation time, use clean pipe materials and work with great attention so that water and others do not mix in because pipes are affected by impurities such as water, oxide scales, oil, etc.

   Use the clean pipes.

   Be sure to brazing with flowing nitrogen gas. (Never use gas other than nitrogen gas.)

4) For the earth protection, use a vacuum pump for air purge.

5) R410A refrigerant is azeotropic mixture type refrigerant.

   Therefore use liquid type to charge the refrigerant. (If using gas for charging, composition of the refrigerant changes and then characteristics of the air conditioner change.)

3. Pipe Materials

For the refrigerant pipes, copper pipe and joints are mainly used.

It is necessary to select the most appropriate pipes to conform to the standard.

Use clean material in which impurities adhere inside of pipe or joint to a minimum.

1) Copper pipe

<Piping>

The pipe thickness, flare finishing size, flare nut and others differ according to a refrigerant type.

When using a long copper pipe for R410A, it is recommended to select “Copper or copper-base pipe without seam” and one with bonded oil amount 0.0001 lbs / 32’ 10” (40 mg / 10 m) or less.

Also do not use crushed, deformed, discolored (especially inside) pipes.
(Impurities cause clogging of expansion valves and capillary tubes.)

<Flare nut>

Use the flare nuts which are attached to the air conditioner unit.

2) Joint

The flare joint and socket joint are used for joints of the copper pipe.

The joints are rarely used for installation of the air conditioner. However clear impurities when using them.

4. Tools

1. Required Tools for R410A

   Mixing of different types of oil may cause a trouble such as generation of sludge, clogging of capillary, etc. Accordingly, the tools to be used are classified into the following three types.

   1) Tools exclusive for R410A (Those which cannot be used for conventional refrigerant (R22))
   2) Tools exclusive for R410A, but can be also used for conventional refrigerant (R22)
   3) Tools commonly used for R410A and for conventional refrigerant (R22)

   The table below shows the tools exclusive for R410A and their interchangeability.

Tools exclusive for R410A (The following tools for R410A are required.)

Tools whose specifications are changed for R410A and their interchangeability

No.	Used tool	Usage	R410A air conditioner installation		Conventional air conditioner installation
			Existence of new equipment for R410A	Whether conventional equipment can be used	Whether conventional equipment can be used
①	Flare tool	Pipe flaring	Yes	*(Note)	Yes
②	Copper pipe gauge for adjusting projection margin	Flaring by conventional flare tool	Yes	*(Note)	*(Note)
③	Torque wrench	Tightening of flare nut	Yes	No	No
④	Gauge manifold	Evacuating, refrigerant charge, run check, etc.	Yes	No	No
⑤	Charge hose				
⑥	Vacuum pump adapter	Vacuum evacuating	Yes	No	Yes
⑦	Electronic balance for refrigerant charging	Refrigerant charge	Yes	Yes	Yes
⑧	Refrigerant cylinder	Refrigerant charge	Yes	No	No
⑨	Leakage detector	Gas leakage check	Yes	No	Yes

NOTE

When flaring is carried out for R410A using the conventional flare tools, adjustment of projection margin is necessary. For this adjustment, a copper pipe gauge, etc. are necessary.

General tools (Conventional tools can be used.)

In addition to the above exclusive tools, the following equipments which serve also for R22 are necessary as the general tools.

1) Vacuum pump. Use vacuum pump by attaching vacuum pump adapter.
2) Torque wrench
3) Pipe cutter
4) Reamer
5) Pipe benderr
6) Level vial
7) Screwdriver (+, –)
8) Spanner or Monkey wrench
9) Hole core drill
10) Hexagon wrench (Opposite side 4mm)
11) Tape measure
12) Metal saw

Also prepare the following equipments for other installation method and run check.

1) Clamp meter
2) Thermometer
3) Insulation resistance tester (Megger)
4) Electroscope

1. SPECIFICATIONS

1-1. Outdoor Unit

<Super Digital Inverter>

Size				018	024	030	036	042
Outdoor model			RAV-	SP180AT2-UL	SP240AT2-UL	SP300AT2-UL	SP360AT2-UL	SP420AT2-UL
Operating range	Cooling	Outdoor Min - Max DB ∗1	(°F)	23 to 109.4				
		Indoor Min - Max DB	(°F)	69.8 to 89.6				
		Indoor Min - Max WB	(°F)	59 to 75.2				
	Heating	Outdoor WB Min - Max	(°F)	–4 to 59				
		Indoor DB Min - Max	(°F)	59 to 86				
Piping	Standard Piping Length		(ft.)	25				
	Min. Piping Length		(ft.)	16’ 5”	16’ 5”	9’ 8”	9’ 8”	9’ 8”
	Max. Piping Length		(ft.)	164’ 1”	164’ 1”	246’ 1”	246’ 1”	246’ 1”
	Lift	(Outdoor below Indoor)	(ft.)	98’ 5”				
	Lift	(Outdoor above Indoor)	(ft.)	98’ 5”				
	Gas Pipe	(Size / connection type)		1/2”	5/8”	5/8”	5/8”	5/8”
	Liquid Pipe	(Size / connection type)		1/4”	3/8”	3/8”	3/8”	3/8”
	Additional refrigerant charge under long piping connection			0.22 oz / ft (65’7”ft to164’1”ft)	0.43 oz / ft (98’5”ft to 164’1”ft)	0.43 oz / ft (98’5”ft to 246’1”ft)		
Electrical	Voltage			208 V / 230 V-1-60 Hz				
	Maximum Running Current Amps		(A)	17	24	24	24	24
	Fuse Rating ∗2			30	40	40	40	40
Compressor	Type			Hermetic compressor				
	Motor		(kw)	1.1	2	3.75	3.75	3.75
	Pole			4	4	4	4	4
Outdoor	Dimensions	Height	(in.)	21.7	35.0	52.8	52.8	52.8
		Width	(in.)	30.7	35.4	35.4	35.4	35.4
		Length	(in.)	11.4	12.6	12.6	12.6	12.6
	Weight -Gross / Net		(lbs.)	98 / 105	144.5 / 157	211.5 / 226	211.5 / 226	211.5 / 226
	Refrigerant charged			3.1	4.6	6.8	6.8	6.8
	Appearance	(Munsell symbol)		Silky shade (Muncel 1Y8.5/0.5)				
	Sound Pressure		(dBa)	48 / 49	49 / 50	50 / 51	52 / 52	52 / 52

∗1 When installed a duct or wind shield so that it is not affected by the wind.
The minimum outside temperature will be 5°F

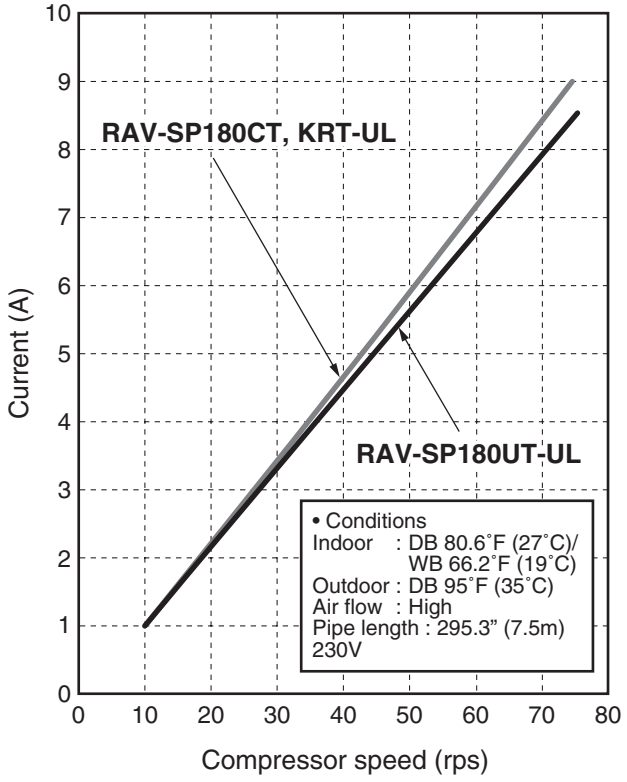
∗2 UL value

1-2. Operation Characteristic CurveRAV*

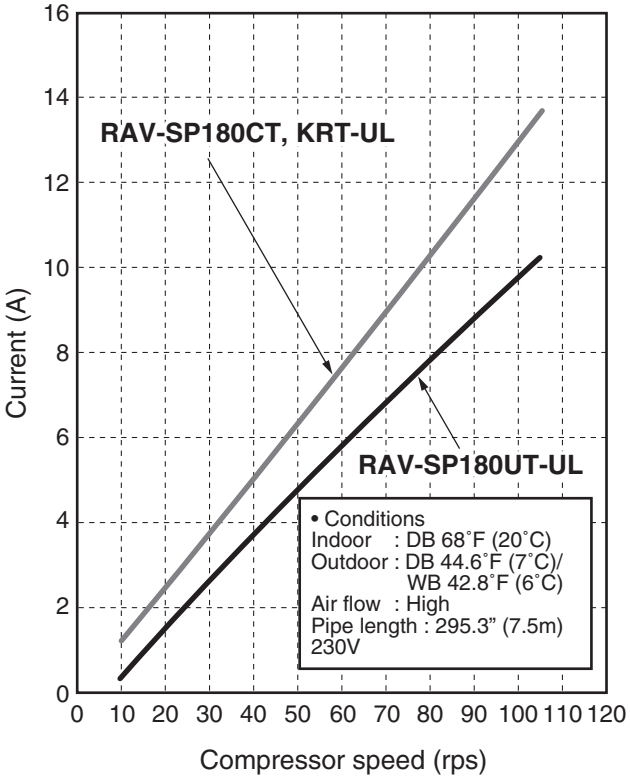
• Operation characteristic curve <Super Digital Inverter>

RAV-SP180AT2-UL

<Cooling>

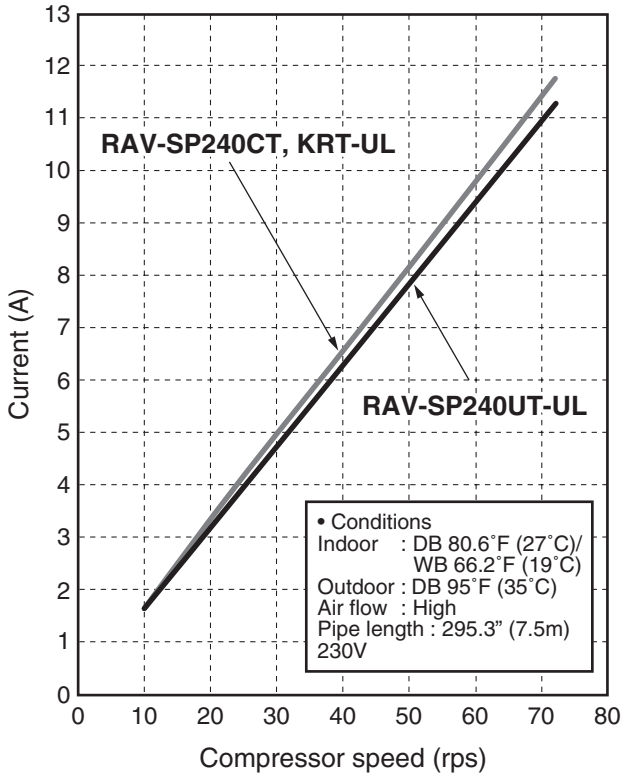


<Heating>



RAV-SP240AT2-UL

<Cooling>



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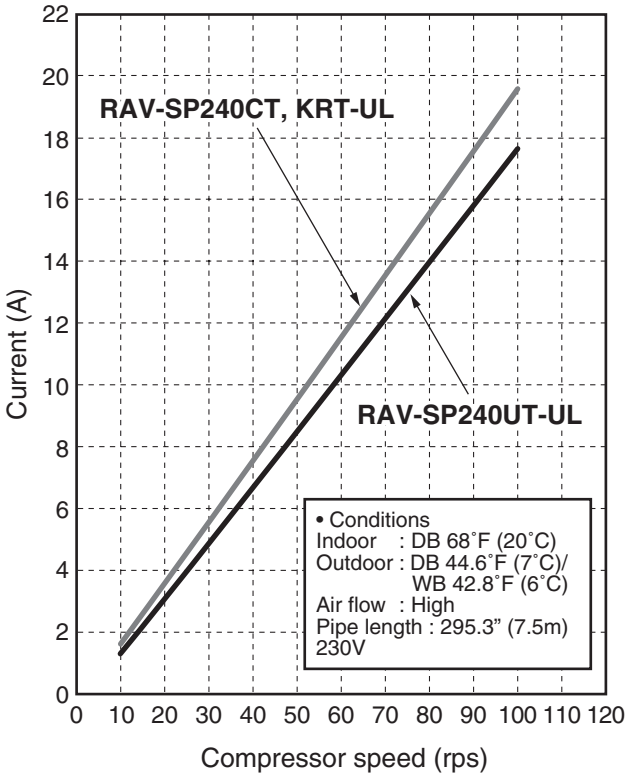
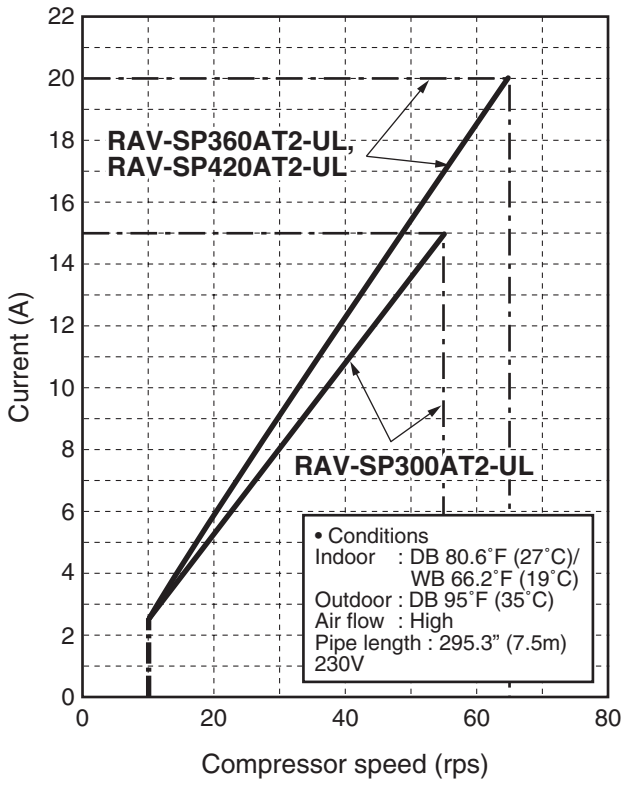


RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL

<Cooling>



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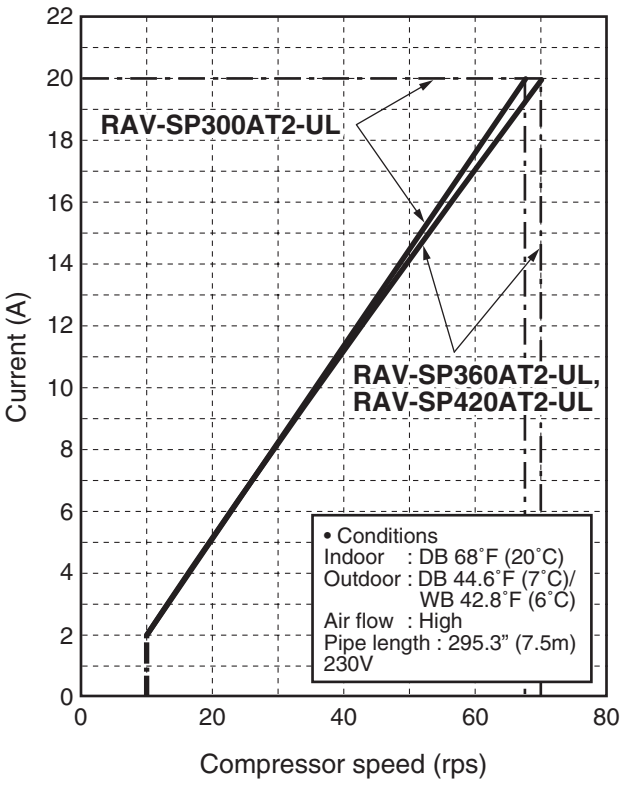
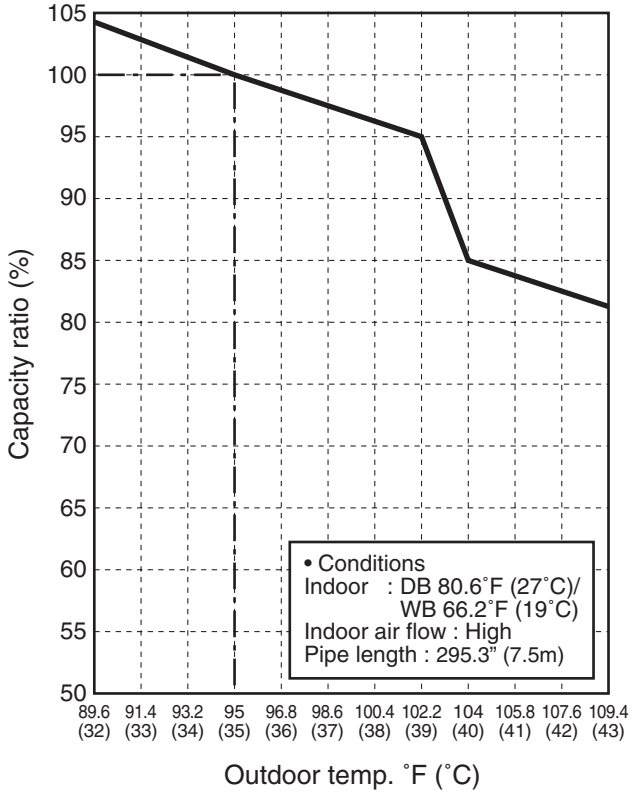


• Capacity variation ratio according to temperature

RAV-SP180AT2-UL, RAV-SP240AT2-UL, RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL

<Cooling>



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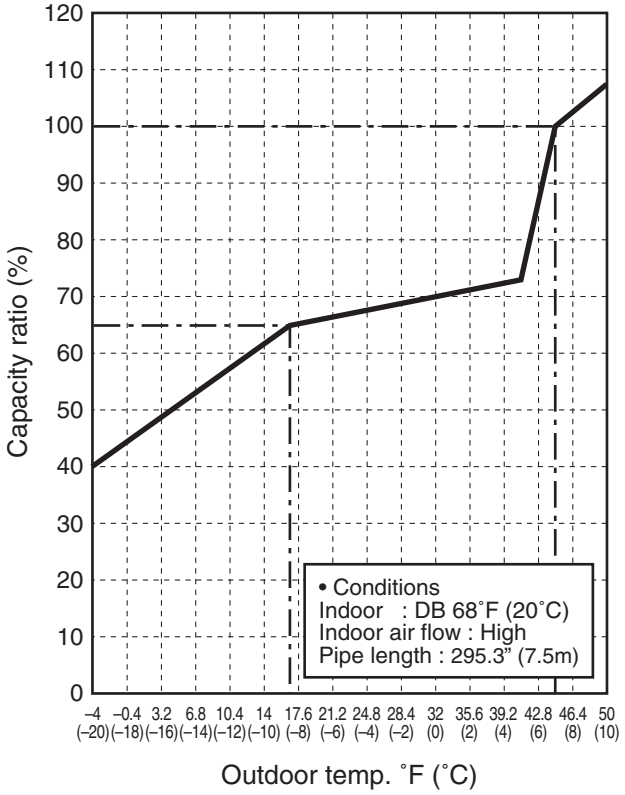
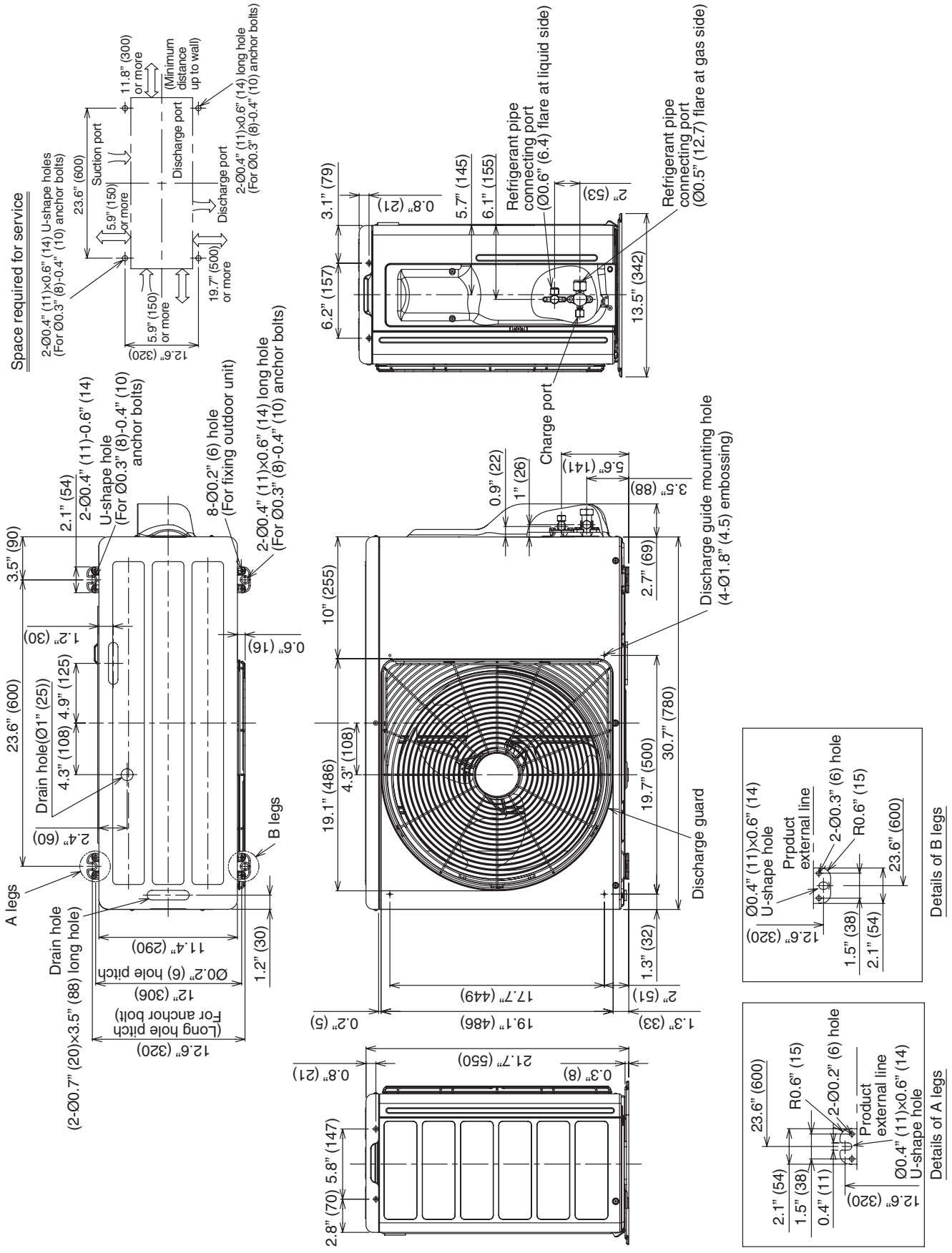

• Conditions
Indoor : DB 68˚F (20˚C)
Indoor air flow : High
Pipe length : 295.3" (7.5m)
Capacity ratio (%)
–4 (–20) –0.4 (–18) 3.2 (–16) 6.8 (–14) 10.4 (–12) 14 (–10) 17.6 (–8) 21.2 (–6) 24.8 (–4) 28.4 (–2) 32 (0) 35.6 (2) 39.2 (4) 42.8 (6) 46.4 (8) 50 (10)
Outdoor temp. ˚F (˚C)

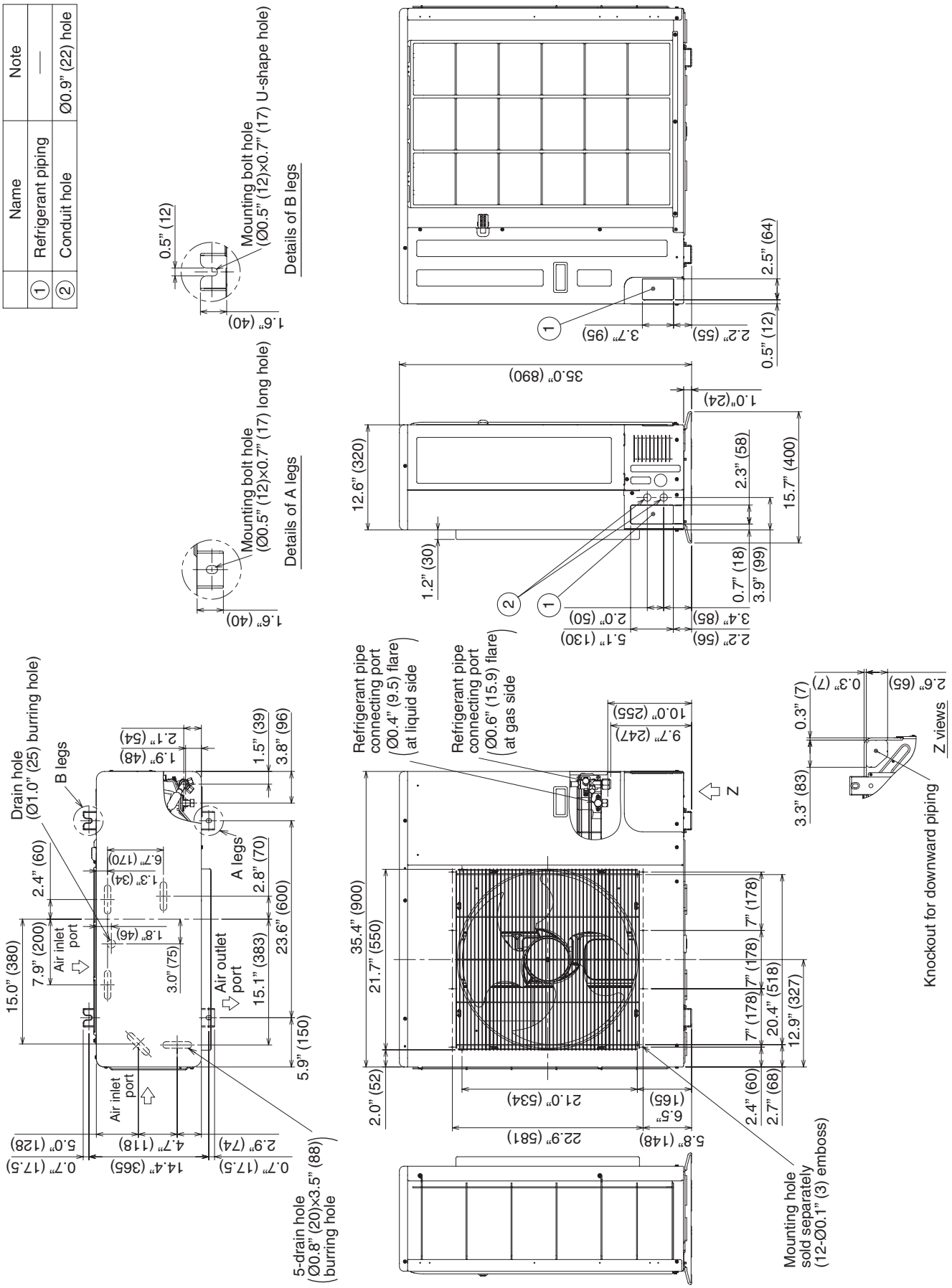
2. CONSTRUCTION VIEWS (EXTERNAL VIEWS)

2-1. Outdoor Unit

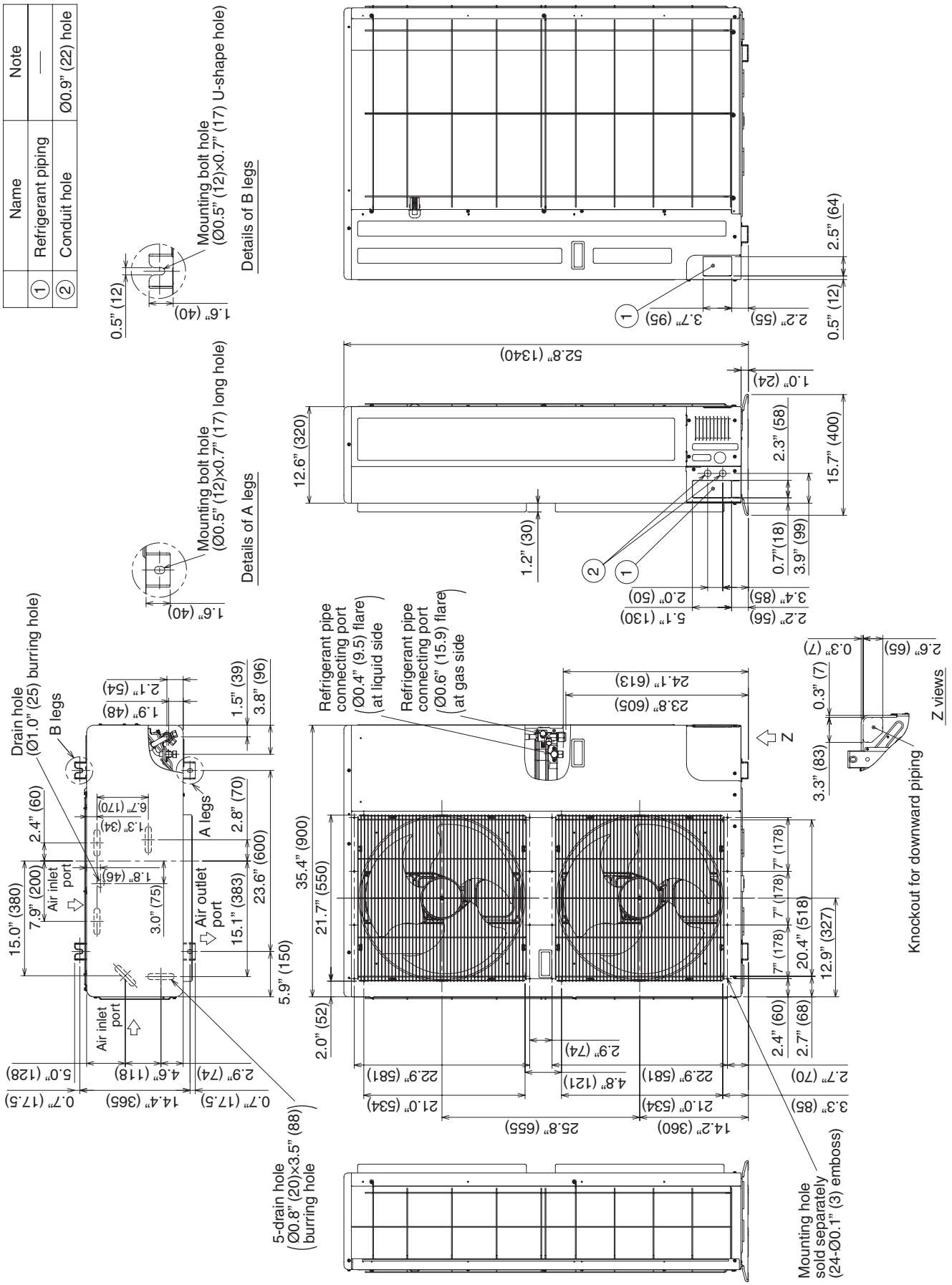
RAV-SP180AT2-UL



RAV-SP240AT2-UL



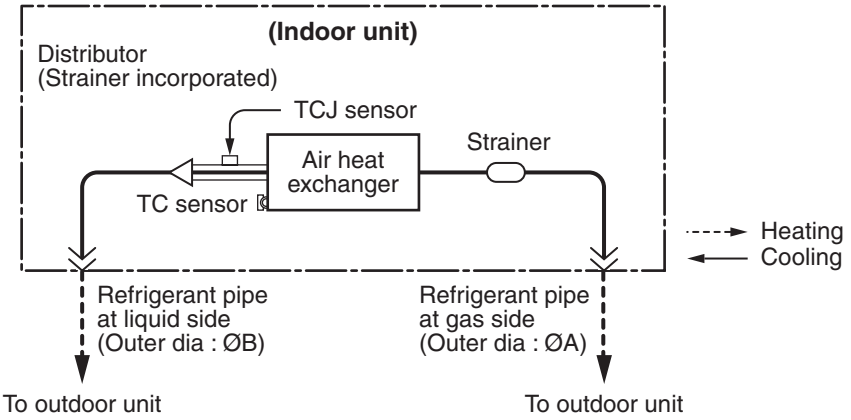
RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL


Name
Note
① Refrigerant piping —
② Conduit hole Ø0.9" (22) hole
Details of B legs
Mounting bolt hole (Ø0.5" (12)×0.7" (17) U-shape hole)
Details of A legs
Mounting bolt hole (Ø0.5" (12)×0.7" (17) long hole)
Drain hole (Ø1.0" (25) burring hole)
B legs
A legs
Air inlet port
Air outlet port
Refrigerant pipe connecting port (Ø0.4" (9.5) flare) at liquid side
Refrigerant pipe connecting port (Ø0.6" (15.9) flare) at gas side
Z views
Knockout for downward piping
5-drain hole (Ø0.8" (20)×3.5" (88)) burring hole
Mounting hole sold separately (24-Ø0.1" (3) emboss)

3. SYSTEMATIC REFRIGERATING CYCLE DIAGRAM

3-1. Indoor Unit

- **Single type (Combination of 1 indoor unit and 1 outdoor unit)**

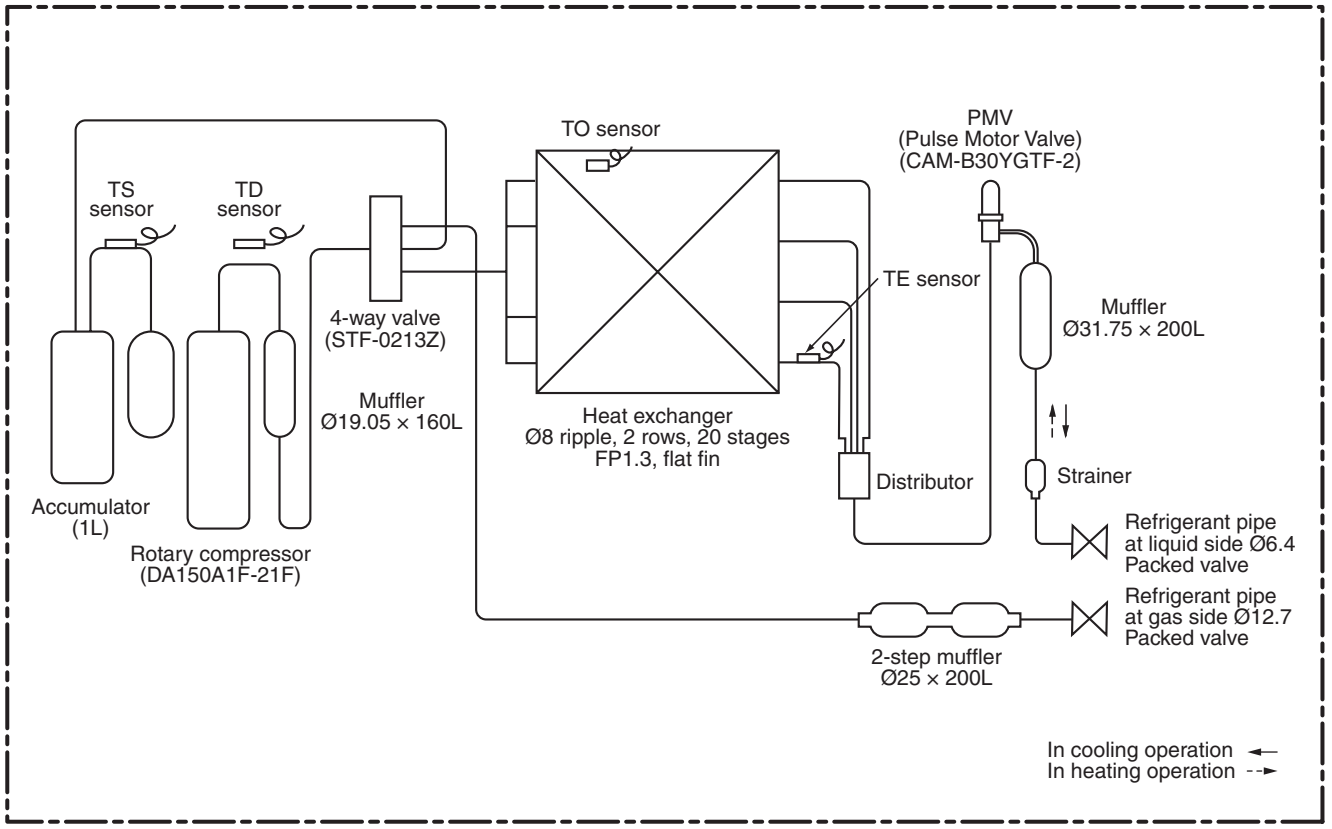


Dimension table

Indoor unit	Outer diameter of refrigerant pipe	
	Gas side ØA	Liquid side ØB
RAV-SP180AT2-UL	1/2” (12.7)	1/4” (6.4)
RAV-SP240, 300, 360, 420AT2-UL	5/8” (15.9)	3/8” (9.5)

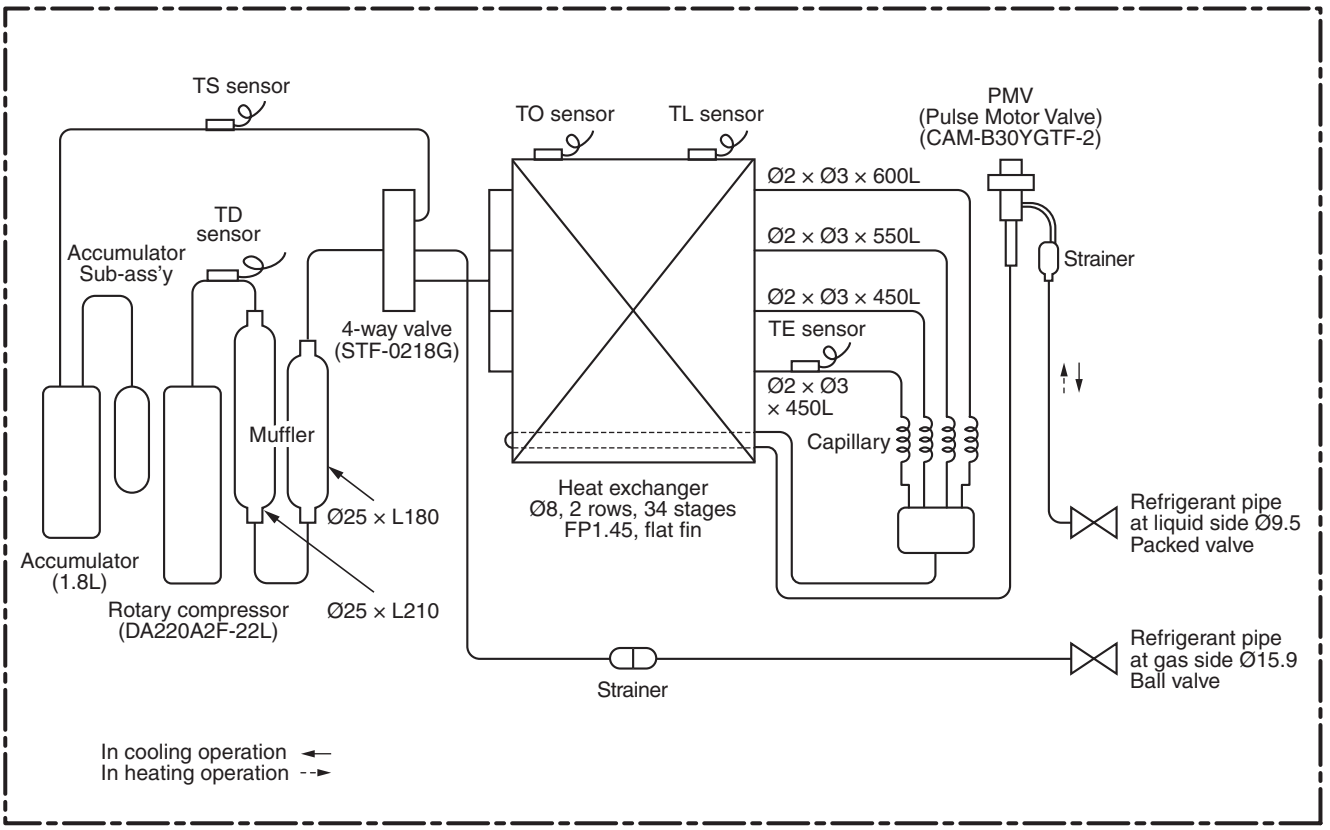
3-2. Outdoor Unit

RAV-SP180AT2-UL



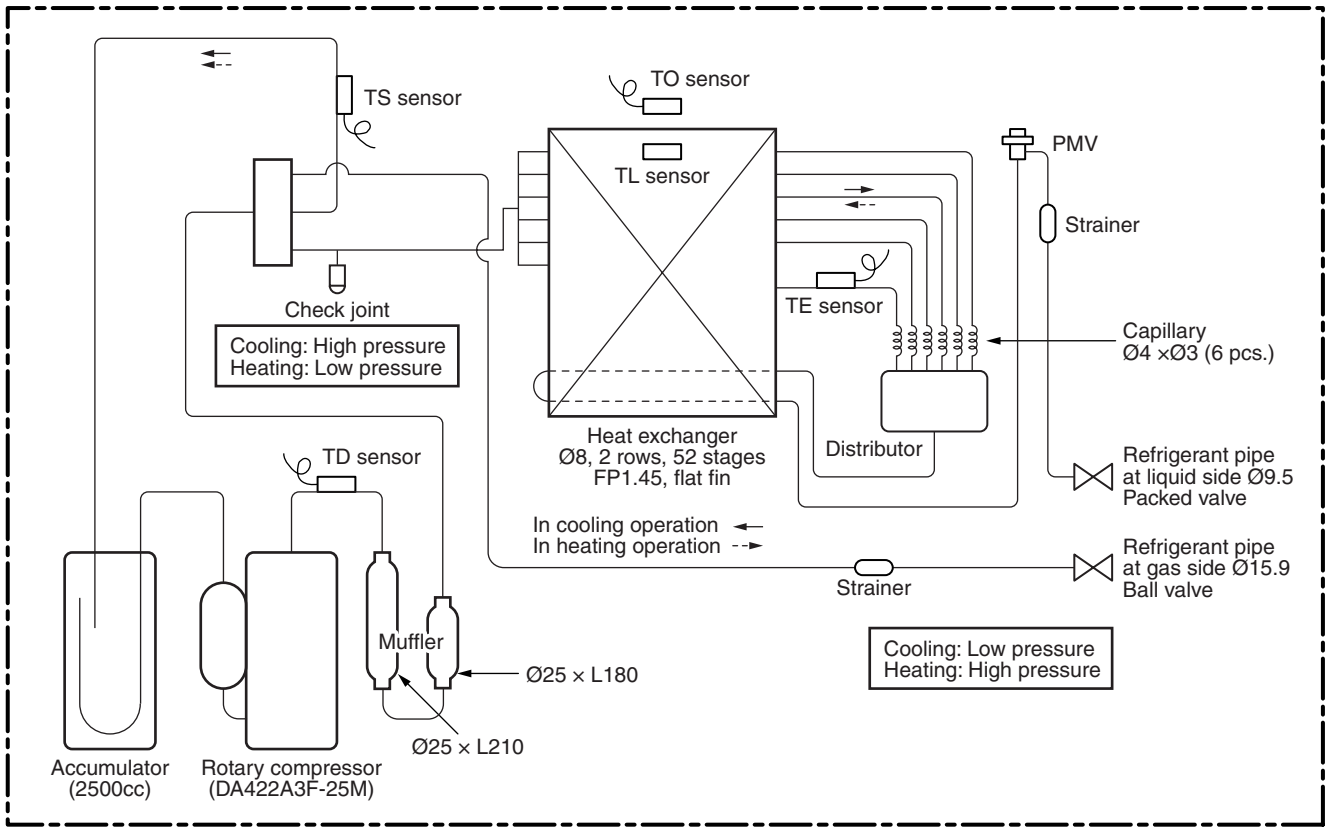
		Pressure				Pipe surface temperature °F (°C)				Compressor drive revolution frequency (rps)	Indoor fan	Indoor/Outdoor temp. conditions (DB/WB) °F °C)	
		(psi)		(MPa)		Discharge	Suction	Indoor heat exchanger	Outdoor heat exchanger				
		Pd	Ps	Pd	Ps	(TD)	(TS)	(TC)	(TE)			Indoor	Outdoor
Cooling	Standard	416.2	145.0	2.87	1.00	161.6 (72)	60.8 (16)	55.4 (13)	107.6 (42)	58	HIGH	80.6/66.2 (27/19)	95/– (35/–)
	Overload	517.7	159.5	3.57	1.10	190.4 (88)	68 (20)	66.2 (19)	125.6 (52)	65	HIGH	89.6/75.2 (32/24)	109.4/– (43/–)
	Low load	248.0	110.2	1.71	0.76	113.0 (45)	53.6 (12)	44.6 (7)	55.4 (13)	30	LOW	64.4/59.9 (18/15.5)	23/– (–5/–)
Heating	Standard	327.7	98.6	2.26	0.68	150.8 (66)	42.8 (6)	98.6 (37)	37.4 (3)	64	HIGH	68/– (20/–)	44.6/42.8 (7/6)
	Overload	471.3	165.3	3.25	1.14	172.4 (78)	68.**0** (20)	127.4 (53)	60.8 (16)	30	LOW	86/– (30/–)	75.2/64.4 (24/18)
	Low load	290.0	36.3	2.00	0.25	172.4 (78)	–0.4 (–18)	93.2 (34)	–0.4 (–18)	88	HIGH	59/– (15/–)	5/– (–15/–)

RAV-SP240AT2-UL



		Pressure				Pipe surface temperature °F (°C)				Compressor drive revolution frequency (rps)	Indoor fan	Indoor/Outdoor temp. conditions (DB/WB) °F °C)	
		(psi)		(MPa)		Discharge	Suction	Indoor heat exchanger	Outdoor heat exchanger				
		Pd	Ps	Pd	Ps	(TD)	(TS)	(TC)	(TE)			Indoor	Outdoor
Cooling	Standard	404.6	129.1	2.79	0.89	158 (70)	55.4 (13)	51.8 (11)	102.2 (39)	58.2	HIGH	80.6/66.2 (27/19)	95/– (35/–)
	Overload	511.9	155.2	3.53	1.07	177.8 (81)	62.6 (17)	57.2 (14)	118.4 (48)	65	HIGH	89.6/75.2 (32/24)	109.4/– (43/–)
	Low load	248.0	104.4	1.71	0.72	107.6 (42)	44.6 (7)	37.4 (3)	64.4 (18)	30	LOW	64.4/59.9 (18/15.5)	23/– (–5/–)
Heating	Standard	384.3	98.6	2.65	0.68	165.2 (74)	39.2 (4)	111.2 (44)	37.4 (3)	61.5	HIGH	68 (20/–)	44.6/42.8 (7/6)
	Overload	464.0	161.0	3.2	1.11	168.8 (76)	66.2 (19)	125.6 (52)	59 (15)	28	LOW	86/– (30/–)	75.2/64.4 (24/18)
	Low load	337.9	30.5	2.33	0.21	199.4 (93)	–0.4 (–18)	87.8 (31)	–4 (–20)	99.6	HIGH	59/– (15/–)	5/– (–15/–)

RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL



RAV-SP300AT2-UL

		Pressure				Pipe surface temperature °F (°C)					Compressor drive revolution frequency (rps)	Indoor fan	Indoor/Outdoor temp. conditions (DB/WB) °F (°C)	
		(psi)		(MPa)		Discharge	Suction	Indoor heat exchanger	Outdoor heat exchanger					
		Pd	Ps	Pd	Ps	(TD)	(TS)	(TC)	(TL)	(TE)			Indoor	Outdoor
Cooling	Standard	372.7	143.6	2.57	0.99	150.8 (66)	57.2 (14)	53.6 (12)	111.2 (44)	104 (38)	38	HIGH	80.6/66.2 (27/19)	95/– (35/–)
	Overload	478.5	158.1	3.30	1.09	172.4 (78)	48.2 (9)	55.4 (13)	120.2 (49)	109.4 (43)	53	HIGH	89.6/75.2 (32/24)	109.4/– (43/–)
	Low load	252.3	108.8	1.74	0.75	114.8 (46)	44.6 (7)	41 (5)	89.6 (32)	77 (25)	21	LOW	64.4/59.9 (18/15.5)	23/– (–5/–)
Heating	Standard	336.4	105.9	2.32	0.73	149 (65)	37.4 (3)	102.2 (39)	35.6 (2)	37.4 (3)	43	HIGH	68/– (20/–)	44.6/42.8 (7/6)
	Overload	466.9	169.7	3.22	1.17	163.4 (73)	66.2 (19)	129.2 (54)	57.2 (14)	59 (15)	26	LOW	86/– (30/–)	75.2/64.4 (24/18)
	Low load	314.7	43.5	2.17	0.30	188.6 (87)	5 (–15)	100.4 (38)	6.8 (–14)	8.6 (–13)	71	HIGH	59/– (15/–)	5/– (–15/–)

∗ This compressor has 4-pole motor. The value when compressor frequency (Hz) is measured by a clamp meter becomes 2 times of No. of compressor revolutions (rps).

RAV-SP360AT2-UL, RAV-SP420AT2-UL

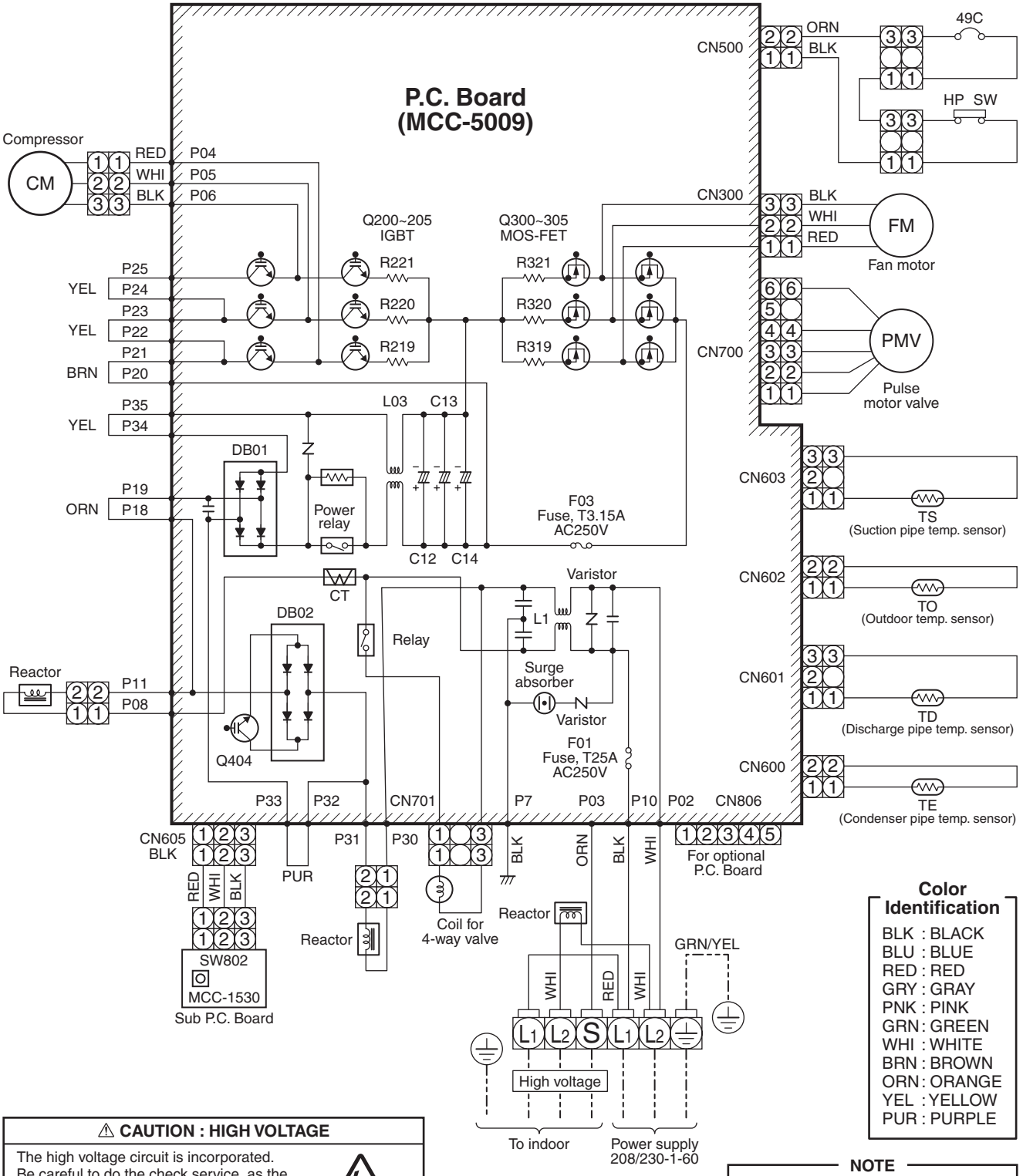
		Pressure				Pipe surface temperature °F (°C)					Compressor drive revolution frequency (rps)	Indoor fan	Indoor/Outdoor temp. conditions (DB/WB) °F (°C)	
		(psi)		(MPa)		Discharge	Suction	Indoor heat exchanger	Outdoor heat exchanger					
		Pd	Ps	Pd	Ps	(TD)	(TS)	(TC)	(TL)	(TE)			Indoor	Outdoor
Cooling	Standard	394.4	130.5	2.72	0.90	163.4 (73)	53.6 (12)	50 (10)	114.8 (46)	100.4 (38)	51	HIGH	80.6/66.2 (27/19)	95/– (35/–)
	Overload	484.3	155.2	3.34	1.07	176 (80)	48.2 (9)	55.4 (13)	123.8 (51)	113 (45)	55	HIGH	89.6/75.2 (32/24)	109.4/– (43/–)
	Low load	253.8	110.2	1.75	0.76	116.6 (47)	46.4 (8)	42.8 (6)	91.4 (33)	77 (25)	21	LOW	64.4/59.9 (18/15.5)	23/– (–5/–)
Heating	Standard	375.6	100.1	2.59	0.69	167 (45)	37.4 (3)	109.4 (43)	35.6 (2)	35.6 (2)	53	HIGH	68/– (20/–)	44.6/42.8 (7/6)
	Overload	453.9	152.3	3.13	1.05	161.6 (72)	60.8 (16)	127.4 (53)	53.6 (12)	55.4 (13)	26	LOW	86/– (30/–)	75.2/64.4 (24/18)
	Low load	348.0	30.45	2.40	0.21	206.6 (97)	–7.6 (–22)	107.6 (42)	–2.2 (–19)	–0.4 (–18)	90	HIGH	59/– (15/–)	5/– (–15/–)

∗ This compressor has 4-pole motor. The value when compressor frequency (Hz) is measured by a clamp meter becomes 2 times of No. of compressor revolutions (rps).

4. WIRING DIAGRAM

4-1. Outdoor Unit

RAV-SP180AT2-UL



Color Identification

BLK : BLACK
BLU : BLUE
RED : RED
GRY : GRAY
PNK : PINK
GRN : GREEN
WHI : WHITE
BRN : BROWN
ORN : ORANGE
YEL : YELLOW
PUR : PURPLE

⚠ CAUTION : HIGH VOLTAGE

The high voltage circuit is incorporated.
Be careful to do the check service, as the electric shock may be caused in case of touching parts on the P.C. board by hand.

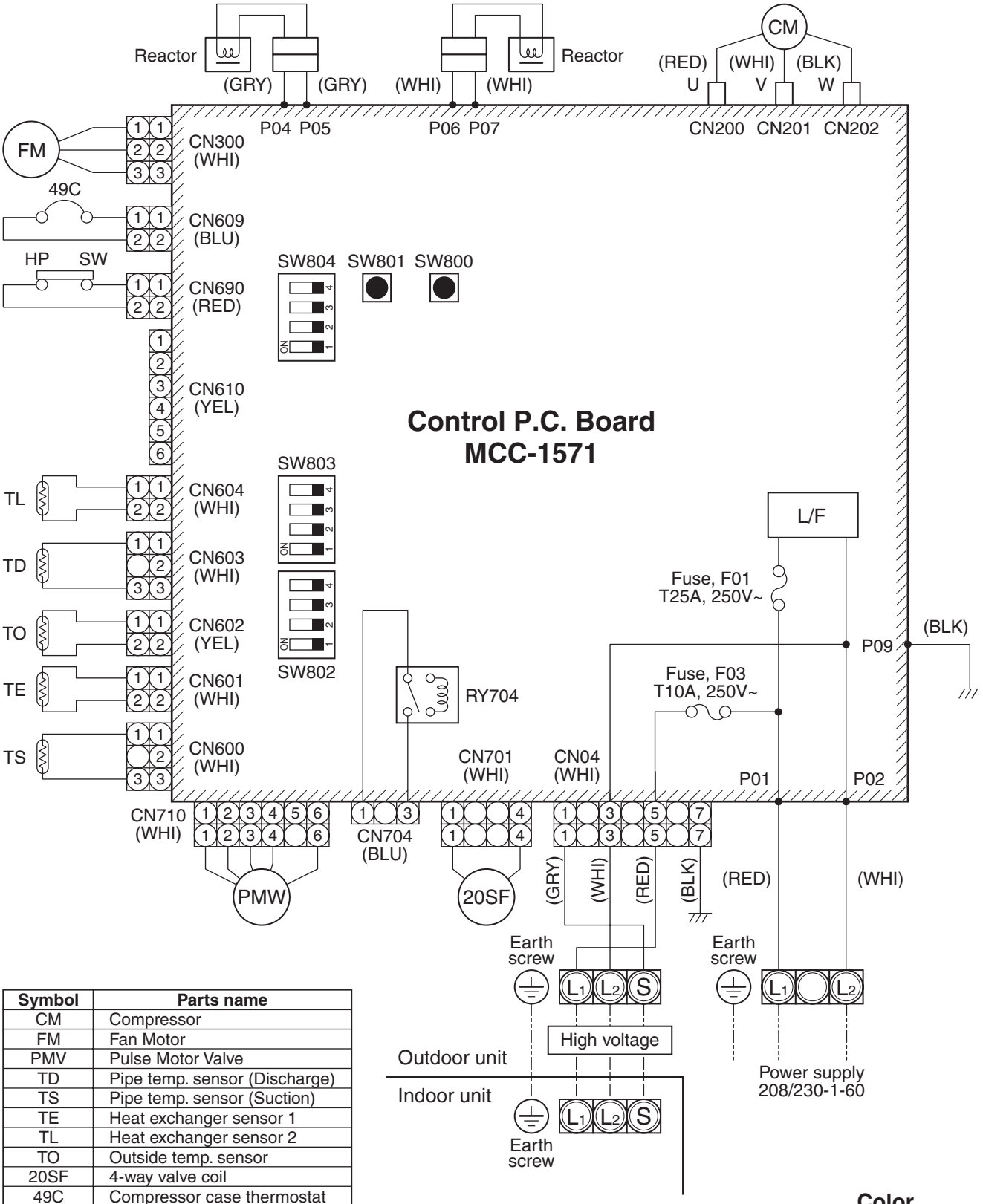
The 4-way valve coil is turned on while the cooling operation

NOTE

CM : Compressor
PMV : Pulse Motor Valve
FM : Fan Motor
TE : Heat Exchanger Temp. Sensor
TD : Discharge Temp. Sensor
TO : Outdoor Temp. Sensor
TS : Suction Temp. Sensor
IGBT : Insulated Gate Bipolar Transistor
DB : Rectifier
CT : Curreut Transformer
49C : Compressor Case Thermostat
HP SW : High pressure switch

1. ◯ indicates the terminal block.
   Alphanumeric characters in the cycle indicate the terminal No.
2. The two-dot chain line indicates the wiring procured locally.
3. ▨ indicates the P.C. board.
4. For the indoor unit circuit, refer to the wiring diagram of the indoor unit.

RAV-SP240AT2-UL



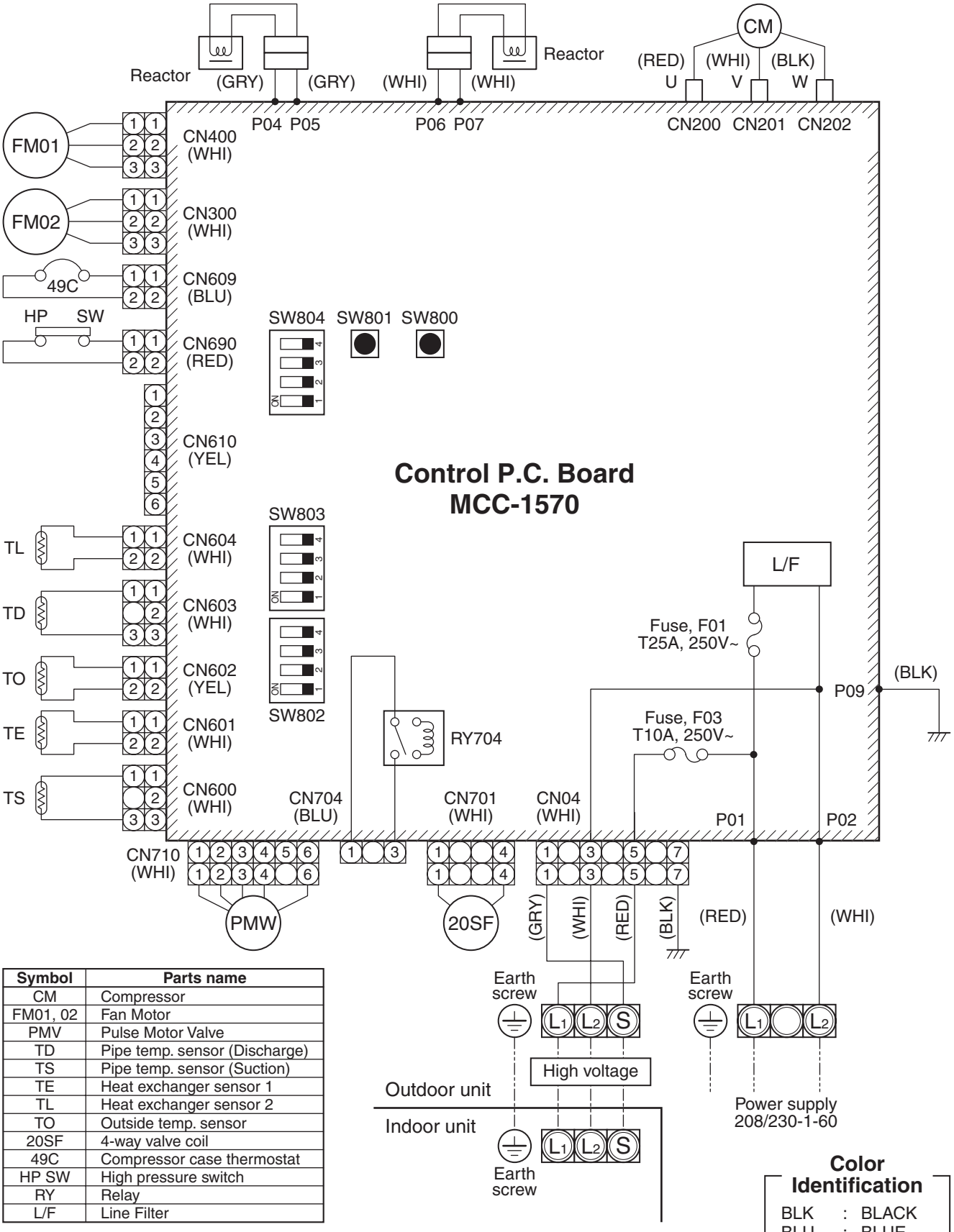
Symbol	Parts name
CM	Compressor
FM	Fan Motor
PMV	Pulse Motor Valve
TD	Pipe temp. sensor (Discharge)
TS	Pipe temp. sensor (Suction)
TE	Heat exchanger sensor 1
TL	Heat exchanger sensor 2
TO	Outside temp. sensor
20SF	4-way valve coil
49C	Compressor case thermostat
HP SW	High pressure switch
RY	Relay
L/F	Line Filter

1. ◎ indicates the terminal block.
   Alphanumeric characters in the cycle indicate the terminal No.
2. The two-dot chain line indicates the wiring procured locally.
3. ▨ indicates the P.C. board.
4. For the indoor unit circuit, refer to the wiring diagram of the indoor unit.

Color Identification

BLK	:	BLACK
BLU	:	BLUE
RED	:	RED
GRY	:	GRAY
WHI	:	WHITE
YEL	:	YELLOW

RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL



Symbol	Parts name
CM	Compressor
FM01, 02	Fan Motor
PMV	Pulse Motor Valve
TD	Pipe temp. sensor (Discharge)
TS	Pipe temp. sensor (Suction)
TE	Heat exchanger sensor 1
TL	Heat exchanger sensor 2
TO	Outside temp. sensor
20SF	4-way valve coil
49C	Compressor case thermostat
HP SW	High pressure switch
RY	Relay
L/F	Line Filter

1. ◎ indicates the terminal block.
   Alphanumeric characters in the cycle indicate the terminal No.
2. The two-dot chain line indicates the wiring procured locally.
3. ▨ indicates the P.C. board.
4. For the indoor unit circuit, refer to the wiring diagram of the indoor unit.

Color Identification

BLK	:	BLACK
BLU	:	BLUE
RED	:	RED
GRY	:	GRAY
WHI	:	WHITE
YEL	:	YELLOW

5. SPECIFICATIONS OF ELECTRICAL PARTS

5-1. Outdoor Unit (Parts Ratings)

RAV-SP180AT2-UL

No.	Parts name	Type	Specifications
1	Fan motor	ICF-140-43-4R	Output (Rated) 43 W
2	Compressor	DA150A1F-21F	3 phase, 4P, 1100 W
3	Reactor	CH-57	10mH, 16A
4	Outdoor temp. sensor (To sensor)	—	10 kΩ at 77°F (25°C)
5	Heat exchanger sensor (Te sensor)	—	10 kΩ at 77°F (25°C)
6	Suction temp. sensor (Ts sensor)	—	10 kΩ at 77°F (25°C)
7	Discharge temp. sensor (Td sensor)	—	50 kΩ at 77°F (25°C)
8	Fuse (Switching power (Protect))	—	T3.15 A, AC 250 V
9	Fuse (Inverter, input (Current protect))	—	AC 240 V, 25 A
10	4-way valve solenoid coil	STF-01AJ502E1	—
11	Compressor thermo. (Protection)	US-622	OFF : 257 ± 39.2°F (125 ± 4°C), ON : 194 ± 41°F (90 ± 5°C)
12	Coil (Pulse Motor Valve)	CAM-MD12TF-12	—
13	Pressure switch	ACB-4UB82W	OFF : 601.8 + 0 − 29 psi (4.15 + 0 / 4.15 − 0.2 MPa) ON : 464 ± 26 psi (3.2 ± 0.2 MPa)

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No.	Parts name	Type	Specifications
1	Compressor	DA220A2F-22L	—
2	Outdoor fan motor	ICF-280-A60-1	Output 60 W
3	Reactor	CH-56	5.8 mH, 18.5 A
4	4-way valve coil	VHV-01AP552B1	AC200 – 240 V
5	PMV coil	CAM-MD12TF-15	DC12 V
6	P.C. board	MCC-1571	AC208 / 230 V
7	Fuse (Mounted on P.C. board)	—	AC250 V, 25 A
8	Fuse (Mounted on P.C. board)	—	AC250 V, 10 A
9	Fuse (Mounted on P.C. board)	—	AC250 V, 3.15 A
10	Outdoor temp. sensor (TO sensor)	—	10 kΩ at 77°F (25°C)
11	Heat exchanger sensor (Te sensor)	—	10 kΩ at 77°F (25°C)
12	Discharge temp. sensor (Td sensor)	—	50 kΩ at 77°F (25°C)
13	Heat exchanger Temp sensor (Ts sensor)	—	10 kΩ at 77°F (25°C)
14	Compressor thermo. (Protection)	US-622	OFF : 257 ± 39.2°F (125 ± 4°C), ON : 194 ± 41°F (90 ± 5°C)
15	Pressure switch	ACB-4UB82W	OFF : 601.8 + 0 − 29 psi (4.15 + 0 / 4.15 − 0.2 MPa) ON : 464 ± 26 psi (3.2 ± 0.2 MPa)

RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL

No.	Parts name	Type	Specifications
1	Compressor	DA422A3F-25M	—
2	Outdoor fan motor	ICF-280-A100-1	Output 100W
3	Reactor	CH-62	5.7mH, 18.5A
4	4-way valve coil	VHV-01AP552B1	AC240V
5	PMV coil	UKV-A038	DC12V
6	P.C. board	MCC-1571	AC208 / 230 V
7	Fuse (Mounted on P.C. board)	—	AC250V, 25A
8	Fuse (Mounted on P.C. board)	—	AC250V, 10A
9	Fuse (Mounted on P.C. board)	—	AC250V, 3.15A
10	Outdoor temp. sensor (TO sensor)	—	10 kΩ at 77°F (25°C)
11	Heat exchanger sensor (Te sensor)	—	10 kΩ at 77°F (25°C)
12	Discharge temp. sensor (Td sensor)	—	50 kΩ at 77°F (25°C)
13	Heat exchanger mid. Temp sensor (TL sensor)	—	10 kΩ at 77°F (25°C)
14	Compressor thermo. (Protection)	US-622	OFF : 257 ± 39.2°F (125 ± 4°C), ON : 194 ± 41°F (90 ± 5°C)
15	Pressure switch	ACB-4UB82W	OFF : 601.8 + 0 − 29 psi (4.15 + 0 / 4.15 − 0.2 MPa) ON : 464 ± 26 psi (3.2 ± 0.2 MPa)

6. REFRIGERANT R410A

This air conditioner adopts the new refrigerant HFC (R410A) which does not damage the ozone layer.

The working pressure of the new refrigerant R410A is 1.6 times higher than conventional refrigerant (R22). The refrigerating oil is also changed in accordance with change of refrigerant, so be careful that water, dust, and existing refrigerant or refrigerating oil are not entered in the refrigerant cycle of the air conditioner using the new refrigerant during installation work or servicing time.

The next section describes the precautions for air conditioner using the new refrigerant.

Conforming to contents of the next section together with the general cautions included in this manual, perform the correct and safe work.

6-1. Safety During Installation/Servicing

As R410A's pressure is about 1.6 times higher than that of R22, improper installation/servicing may cause a serious trouble. By using tools and materials exclusive for R410A, it is necessary to carry out installation/servicing safely while taking the following precautions into consideration.

1. Never use refrigerant other than R410A in an air conditioner which is designed to operate with R410A.

   If other refrigerant than R410A is mixed, pressure in the refrigeration cycle becomes abnormally high, and it may cause personal injury, etc. by a rupture.
2. Confirm the used refrigerant name, and use tools and materials exclusive for the refrigerant R410A.

   The refrigerant name R410A is indicated on the visible place of the outdoor unit of the air conditioner using R410A as refrigerant.

   To prevent mischarging, the diameter of the service port differs from that of R22.
3. If a refrigeration gas leakage occurs during installation/servicing, be sure to ventilate fully.

   If the refrigerant gas comes into contact with fire, a poisonous gas may occur.
4. When installing or removing an air conditioner, do not allow air or moisture to remain in the refrigeration cycle.

   Otherwise, pressure in the refrigeration cycle may become abnormally high so that a rupture or personal injury may be caused.
5. After completion of installation work, check to make sure that there is no refrigeration gas leakage.

   If the refrigerant gas leaks into the room, coming into contact with fire in the fan-driven heater, space heater, etc., a poisonous gas may occur.
6. When an air conditioning system charged with a large volume of refrigerant is installed in a small room, it is necessary to exercise care so that, even when refrigerant leaks, its concentration does not exceed the marginal level.

   If the refrigerant gas leakage occurs and its concentration exceeds the marginal level, an oxygen starvation accident may result.
7. Be sure to carry out installation or removal according to the installation manual.

   Improper installation may cause refrigeration trouble, water leakage, electric shock, fire, etc.
8. Unauthorized modifications to the air conditioner may be dangerous. If a breakdown occurs please call a qualified air conditioner technician or electrician.

   Improper repair may result in water leakage, electric shock and fire, etc.

6-2. Refrigerant Piping Installation

6-2-1. Piping Materials and Joints Used

For the refrigerant piping installation, copper pipes and joints are mainly used.

Copper pipes and joints suitable for the refrigerant must be chosen and installed.

Furthermore, it is necessary to use clean copper pipes and joints whose interior surfaces are less affected by contaminants.

1. Copper Pipes

   It is necessary to use seamless copper pipes which are made of either copper or copper alloy and it is desirable that the amount of residual oil is less than 0.0001 lbs / 32' 10" (40 mg/10 m).

   Do not use copper pipes having a collapsed, deformed or discolored portion (especially on the interior surface).

   Otherwise, the expansion valve or capillary tube may become blocked with contaminants.

   As an air conditioner using R410A incurs pressure higher than when using R22, it is necessary to choose adequate materials.

   Thicknesses of copper pipes used with R410A are as shown in Table 6-2-1. Never use copper pipes thinner than 0.03" (0.8 mm) even when it is available on the market.

Table 6-2-1 Thicknesses of annealed copper pipes

	Thickness (In (mm))	
Outer diameter (In (mm))	**R410A**	**R22**
1/4" (6.4)	0.03" (0.80)	0.03" (0.80)
3/8" (9.5)	0.03" (0.80)	0.03" (0.80)
1/2" (12.7)	0.03" (0.80)	0.03" (0.80)
5/8" (15.9)	0.04" (1.00)	0.04" (1.00)

1. Joints

   For copper pipes, flare joints or socket joints are used. Prior to use, be sure to remove all contaminants.

   a) Flare Joints

      Flare joints used to connect the copper pipes cannot be used for pipings whose outer diameter exceeds 20 mm. In such a case, socket joints can be used.

      Sizes of flare pipe ends, flare joint ends and flare nuts are as shown in Tables 6-2-3 to 6-2-5 below.

   b) Socket Joints

      Socket joints are such that they are brazed for connections, and used mainly for thick pipings whose diameter is larger than 0.79" (20 mm). Thicknesses of socket joints are as shown in Table 6-2-2.

Table 6-2-2 Minimum thicknesses of socket joints

Reference outer diameter of copper pipe jointed (In (mm))	Minimum joint thickness (In (mm))
1/4" (6.4)	0.02" (0.50)
3/8" (9.5)	0.02" (0.60)
1/2" (12.7)	0.03" (0.70)
5/8" (15.9)	0.03" (0.80)

6-2-2. Processing of Piping Materials

When performing the refrigerant piping installation, care should be taken to ensure that water or dust does not enter the pipe interior, that no other oil other than lubricating oils used in the installed air conditioner is used, and that refrigerant does not leak.

When using lubricating oils in the piping processing, use such lubricating oils whose water content has been removed. When stored, be sure to seal the container with an airtight cap or any other cover.

1. Flare Processing Procedures and Precautions

   a) Cutting the Pipe

      By means of a pipe cutter, slowly cut the pipe so that it is not deformed.

   b) Removing Burrs and Chips

      If the flared section has chips or burrs, refrigerant leakage may occur.

      Carefully remove all burrs and clean the cut surface before installation.

c) Insertion of Flare Nut

d) Flare Processing

Make certain that a clamp bar and copper pipe have been cleaned.

By means of the clamp bar, perform the flare processing correctly.

Use either a flare tool for R410A or conventional flare tool.

Flare processing dimensions differ according to the type of flare tool.

When using a conventional flare tool, be sure to secure “dimension A” by using a gauge for size adjustment.

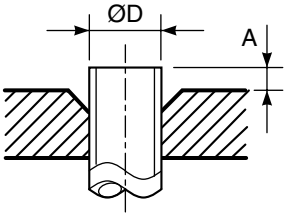


Fig. 6-2-1 Flare processing dimensions

Table 6-2-3 Dimensions related to flare processing for R410A / R22

Outer diameter (In (mm))	Thickness (In (mm))	A (In (mm))		
		Flare tool for R410A, R22clutch type	Conventional flare tool (R410A)	
			Clutch type	Wing nut type
1/4” (6.4)	0.03” (0.8)	0 – 0.02” (0 – 0.5)	0.04” – 0.06” (1.0 – 1.5)	0.06” – 0.08” (1.5 – 2.0)
3/8” (9.5)	0.03” (0.8)	0 – 0.02” (0 – 0.5)	0.04” – 0.06” (1.0 – 1.5)	0.06” – 0.08” (1.5 – 2.0)
1/2” (12.7)	0.03” (0.8)	0 – 0.02” (0 – 0.5)	0.04” – 0.06” (1.0 – 1.5)	0.08” – 0.10” (2.0 – 2.5)
5/8” (15.9)	0.04” (1.0)	0 – 0.02” (0 – 0.5)	0.04” – 0.06” (1.0 – 1.5)	0.08” – 0.10” (2.0 – 2.5)

Table 6-2-4 Flare and flare nut dimensions for R410A

Outer diameter (In (mm))	Thickness (In (mm))	Dimension (In (mm))				Flare nut width (In (mm))
		A	B	C	D	
1/4” (6.4)	0.03” (0.8)	0.36” (9.1)	0.36” (9.2)	0.26” (6.5)	0.51” (13)	0.67” (17)
3/8” (9.5)	0.03” (0.8)	0.52” (13.2)	0.53” (13.5)	0.38” (9.7)	0.79” (20)	0.87” (22)
1/2” (12.7)	0.03” (0.8)	0.65” (16.6)	0.63” (16.0)	0.51” (12.9)	0.91” (23)	1.02” (26)
5/8” (15.9)	0.04” (1.0)	0.78” (19.7)	0.75” (19.0)	0.63” (16.0)	0.98” (25)	1.14” (29)

Table 6-2-5 Flare and flare nut dimensions for R22

Outer diameter (In (mm))	Thickness (In (mm))	Dimension (In (mm))				Flare nut width (In (mm))
		A	B	C	D	
1/4” (6.4)	0.03” (0.8)	0.36” (9.1)	0.36” (9.2)	0.26” (6.5)	0.51” (13)	0.67” (17)
3/8” (9.5)	0.03” (0.8)	0.51” (13.0)	0.53” (13.5)	0.38” (9.7)	0.79” (20)	0.87” (22)
1/2” (12.7)	0.03” (0.8)	0.64” (16.2)	0.63” (16.0)	0.51” (12.9)	0.79” (20)	0.94” (24)
5/8” (15.9)	0.04” (1.0)	0.76” (19.4)	0.75” (19.0)	0.63” (16.0)	0.91” (23)	1.06” (27)
3/4” (19.0)	0.04” (1.0)	0.92” (23.3)	0.94” (24.0)	0.76” (19.2)	1.34” (34)	1.42” (36)

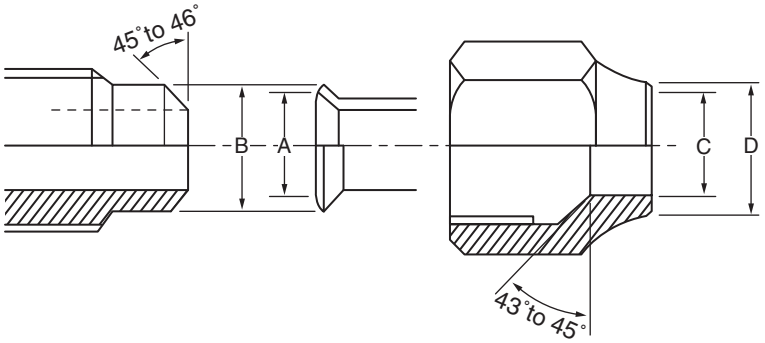


Fig. 6-2-2 Relations between flare nut and flare seal surface

2. Flare Connecting Procedures and Precautions
   a) Make sure that the flare and union portions do not have any scar or dust, etc.
   b) Correctly align the processed flare surface with the union axis.
   c) Tighten the flare with designated torque by means of a torque wrench.
      The tightening torque for R410A is the same as that for conventional R22.
      Incidentally, when the torque is weak, the gas leakage may occur.
      When it is strong, the flare nut may crack and may be made non-removable.
      When choosing the tightening torque, comply with values designated by manufacturers.
      Table 6-2-6 shows reference values.

NOTE

When applying oil to the flare surface, be sure to use oil designated by the manufacturer.
If any other oil is used, the lubricating oils may deteriorate and cause the compressor to burn out.

Table 6-2-6 Tightening torque of flare for R410A [Reference values]

Outer diameter (In (mm))	Tightening torque (ft • lbs (N • m))
1/4" (6.4)	10 – 13 (14 – 18)
3/8" (9.5)	24 – 31 (33 – 42)
1/2" (12.7)	37 – 46 (50 – 62)
5/8" (15.9)	50 – 60 (68 – 82)

6-3. Tools

6-3-1. Required Tools

Refer to the "**4. Tools**" (Page 8)

6-4. Recharging of Refrigerant

When it is necessary to recharge refrigerant, charge the specified amount of new refrigerant according to the following steps.

Recover the refrigerant, and check no refrigerant remains in the equipment.

↓

Connect the charge hose to packed valve service port at the outdoor unit's gas side.

↓

Connect the charge hose of the vacuum pump adapter.

↓

Open fully both packed valves at liquid and gas sides.

↓

Place the handle of the gauge manifold Low in the fully opened position, and turn on the vacuum pump's power switch. Then, evacuating the refrigerant in the cycle.

↓

When the compound gauge's pointer has indicated –101 kpa (–76 cmHg), place the handle Low in the fully closed position, and turn off the vacuum pump's power switch.

↓

Keep the status as it is for 1 to 2 minutes, and ensure that the compound gauge's pointer does not return.

↓

Set the refrigerant cylinder to the electronic balance, connect the connecting hose to the cylinder and the connecting port of the electronic balance, and charge **liquid refrigerant.**

(For refrigerant charging, see the figure below.)

1) Never charge refrigerant exceeding the specified amount.
2) If the specified amount of refrigerant cannot be charged, charge refrigerant bit by bit in COOL mode.
3) Do not carry out additional charging.

   When additional charging is carried out if refrigerant leaks, the refrigerant composition changes in the refrigeration cycle, that is characteristics of the air conditioner changes, refrigerant exceeding the specified amount is charged, and working pressure in the refrigeration cycle becomes abnormally high pressure, and may cause a rupture or personal injury.

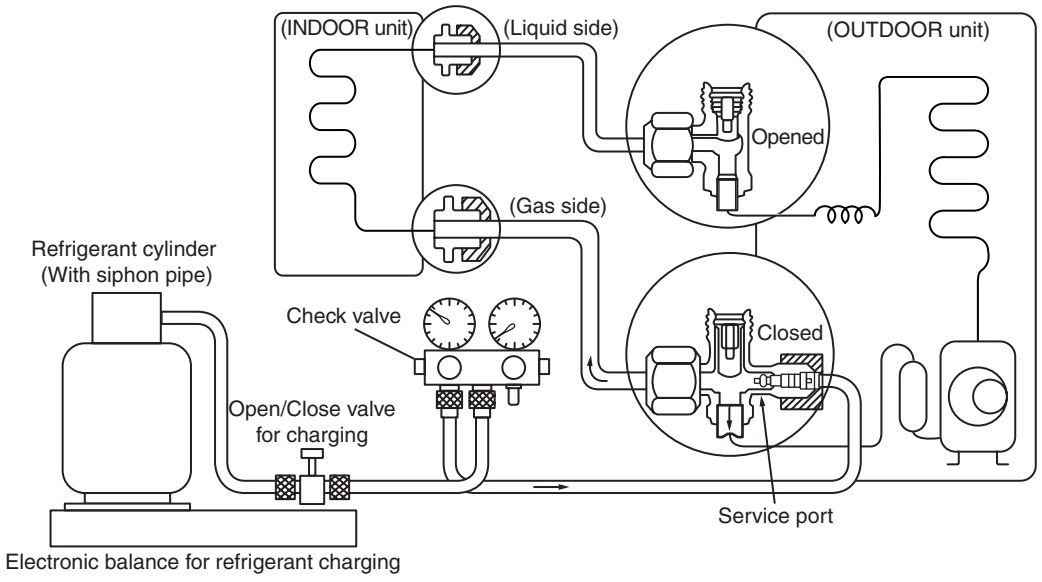
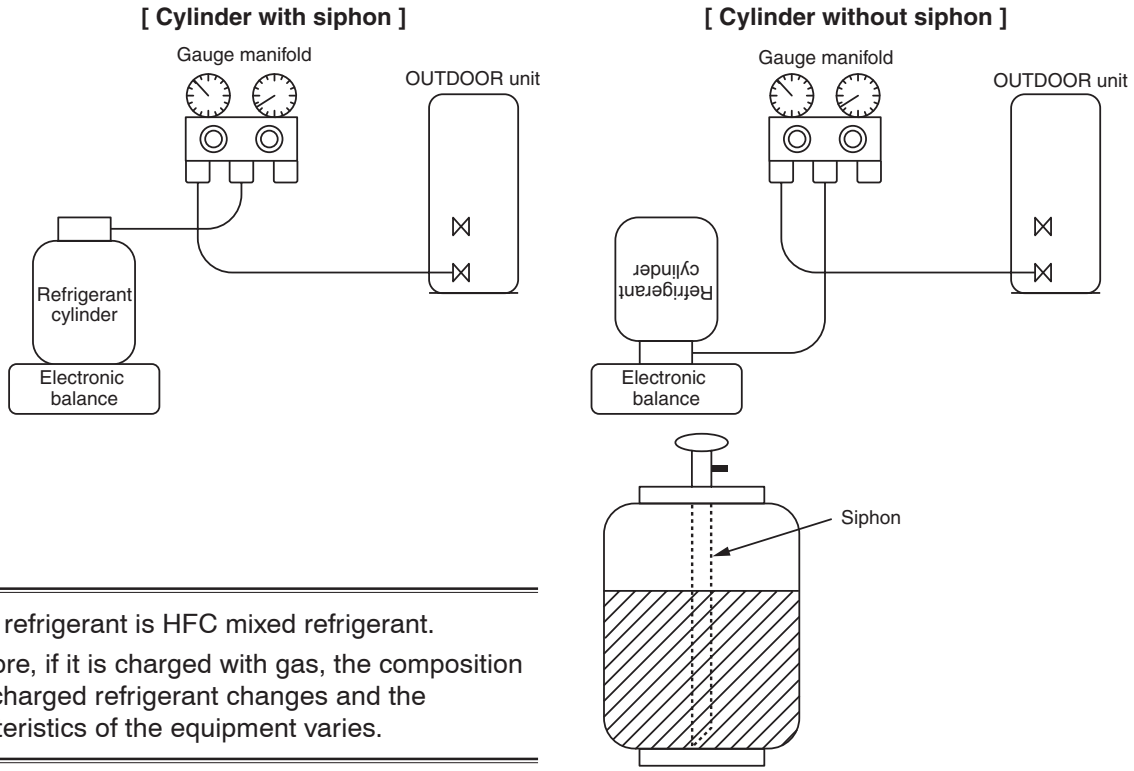


Fig. 6-4-1 Configuration of refrigerant charging

1) Be sure to make setting so that liquid can be charged.
2) When using a cylinder equipped with a siphon, liquid can be charged without turning it upside down.

It is necessary for charging refrigerant under condition of liquid because R410A is mixed type of refrigerant.

Accordingly, when charging refrigerant from the refrigerant cylinder to the equipment, charge it turning the cylinder upside down if cylinder is not equipped with siphon.



R410A refrigerant is HFC mixed refrigerant.

Therefore, if it is charged with gas, the composition of the charged refrigerant changes and the characteristics of the equipment varies.

Fig. 6-4-2

6-5. Brazing of Pipes

6-5-1. Materials for Brazing

1. Silver brazing filler

Silver brazing filler is an alloy mainly composed of silver and copper.

It is used to join iron, copper or copper alloy, and is relatively expensive though it excels in solderability.

2. Phosphor bronze brazing filler

Phosphor bronze brazing filler is generally used to join copper or copper alloy.

3. Low temperature brazing filler

Low temperature brazing filler is generally called solder, and is an alloy of tin and lead.

Since it is weak in adhesive strength, do not use it for refrigerant pipes.

1) Phosphor bronze brazing filler tends to react with sulfur and produce a fragile compound water solution, which may cause a gas leakage. Therefore, use any other type of brazing filler at a hot spring resort, etc., and coat the surface with a paint.
2) When performing brazing again at time of servicing, use the same type of brazing filler.

6-5-2. Flux

1. Reason why flux is necessary

- By removing the oxide film and any foreign matter on the metal surface, it assists the flow of brazing filler.
- In the brazing process, it prevents the metal surface from being oxidized.
- By reducing the brazing filler's surface tension, the brazing filler adheres better to the treated metal.

2. Characteristics required for flux

- Activated temperature of flux coincides with the brazing temperature.
- Due to a wide effective temperature range, flux is hard to carbonize.
- It is easy to remove slag after brazing.
- The corrosive action to the treated metal and brazing filler is minimum.
- It excels in coating performance and is harmless to the human body.

As the flux works in a complicated manner as described above, it is necessary to select an adequate type of flux according to the type and shape of treated metal, type of brazing filler and brazing method, etc.

3. Types of flux

- **Noncorrosive flux**

  Generally, it is a compound of borax and boric acid.

  It is effective in case where the brazing temperature is higher than 1,472°F (800°C).

- **Activated flux**

  Most of fluxes generally used for silver brazing are this type.

  It features an increased oxide film removing capability due to the addition of compounds such as potassium fluoride, potassium chloride and sodium fluoride to the borax-boric acid compound.

4. Piping materials for brazing and used brazing filler/flux

Piping material	Used brazing filler	Used flux
Copper - Copper	Phosphor copper	Do not use
Copper - Iron	Silver	Paste flux
Iron - Iron	Silver	Vapor flux

1) Do not enter flux into the refrigeration cycle.
2) When chlorine contained in the flux remains within the pipe, the lubricating oil deteriorates.
   Therefore, use a flux which does not contain chlorine.
3) When adding water to the flux, use water which does not contain chlorine
   (e.g. distilled water or ion-exchange water).
4) Remove the flux after brazing.

6-5-3. Brazing

As brazing work requires sophisticated techniques, experiences based upon a theoretical knowledge, it must be performed by a person qualified.

In order to prevent the oxide film from occurring in the pipe interior during brazing, it is effective to proceed with brazing while letting dry Nitrogen gas flow.

Never use gas other than Nitrogen gas.

1. Brazing method to prevent oxidation

1) Attach a reducing valve and a flow-meter to the Nitrogen gas cylinder.
2) Use a copper pipe to direct the piping material, and attach a flow-meter to the cylinder.
3) Apply a seal onto the clearance between the piping material and inserted copper pipe for Nitrogen in order to prevent backflow of the Nitrogen gas.
4) When the Nitrogen gas is flowing, be sure to keep the piping end open.
5) Adjust the flow rate of Nitrogen gas so that it is lower than 0.05 m³/Hr or 2.9 psi (0.02 MPa) by means of the reducing valve.
6) After performing the steps above, keep the Nitrogen gas flowing until the pipe cools down to a certain extent (temperature at which pipes are touchable with hands).
7) Remove the flux completely after brazing.

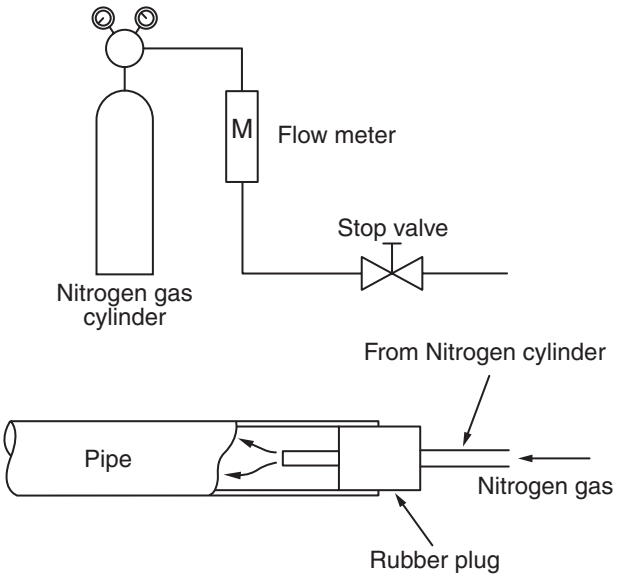


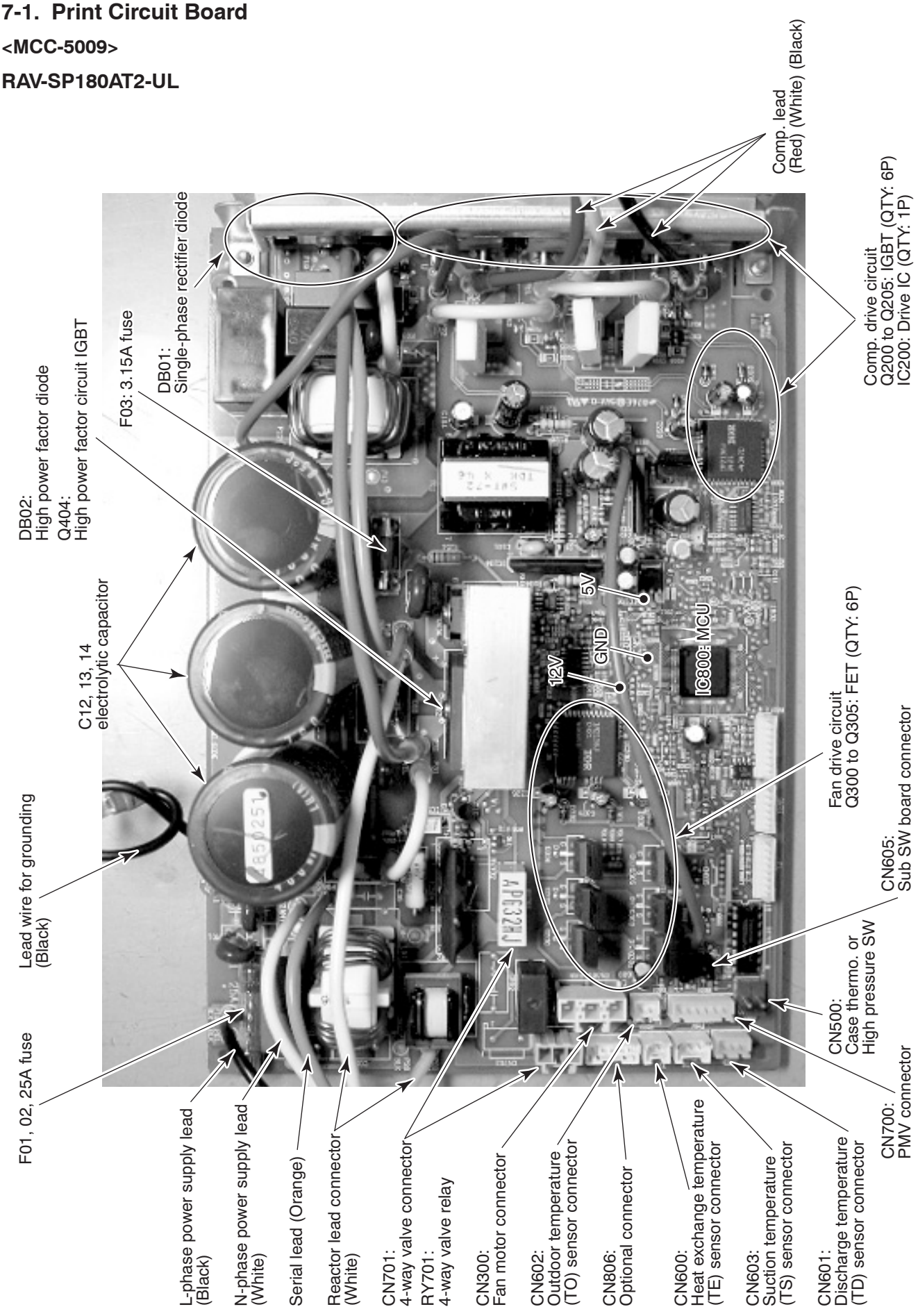
Fig. 6-5-1 Prevention of oxidation during brazing

7. CIRCUIT CONFIGURATION AND CONTROL SPECIFICATIONS

7-1. Print Circuit Board

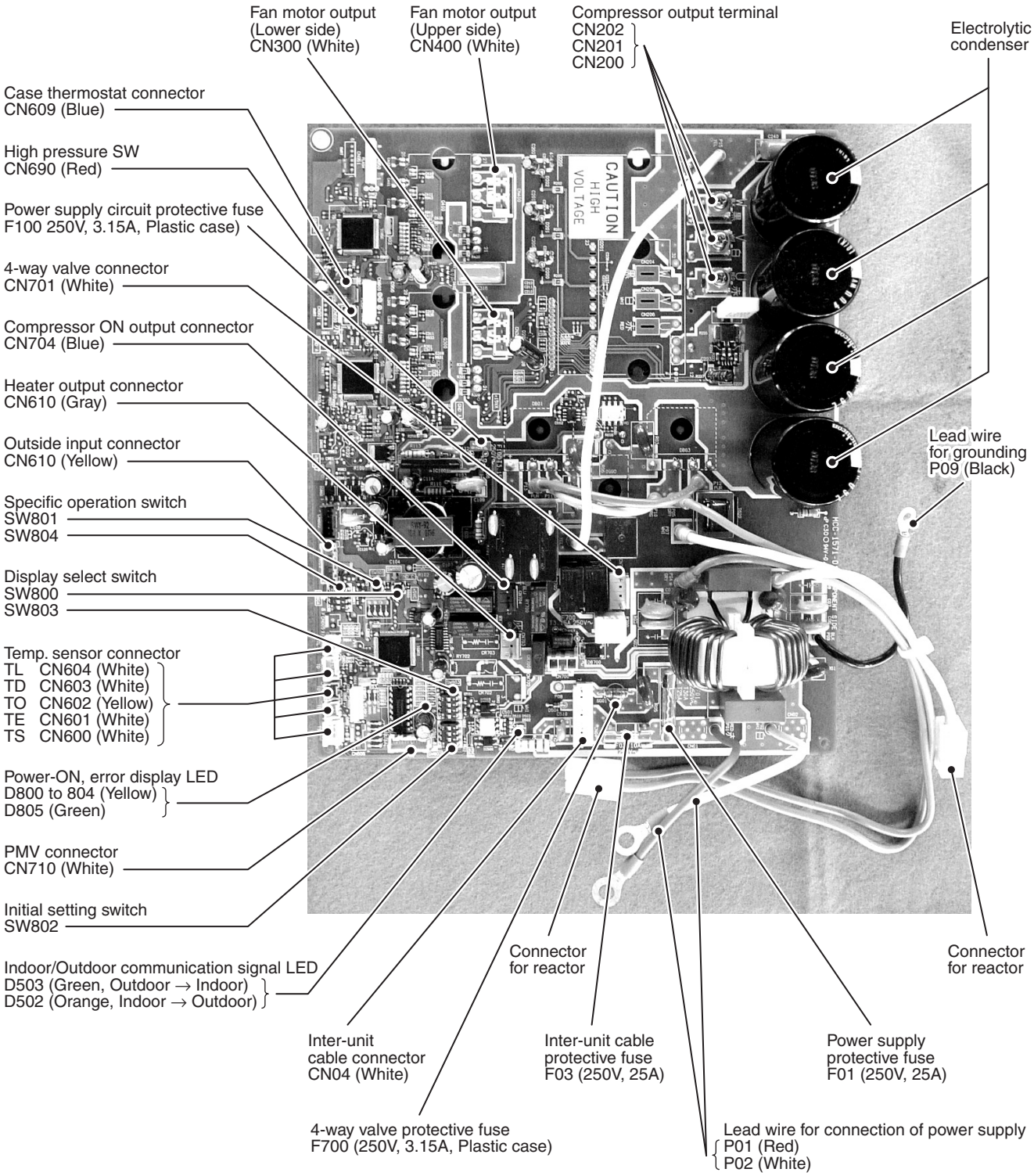
<MCC-5009>

RAV-SP180AT2-UL


F01, 02, 25A fuse
Lead wire for grounding (Black)
C12, 13, 14 electrolytic capacitor
DB02: High power factor diode
Q404: High power factor circuit IGBT
F03: 3.15A fuse
DB01: Single-phase rectifier diode
Comp. lead (Red) (White) (Black)
Comp. drive circuit Q200 to Q205: IGBT (QTY: 6P) IC200: Drive IC (QTY: 1P)
5V
GND
12V
IC800: MCU
Fan drive circuit Q300 to Q305: FET (QTY: 6P)
CN605: Sub SW board connector
CN500: Case thermo. or High pressure SW
CN700: PMV connector
L-phase power supply lead (Black)
N-phase power supply lead (White)
Serial lead (Orange)
Reactor lead connector (White)
CN701: 4-way valve connector
RY701: 4-way valve relay
CN300: Fan motor connector
CN602: Outdoor temperature (TO) sensor connector
CN806: Optional connector
CN600: Heat exchange temperature (TE) sensor connector
CN603: Suction temperature (TS) sensor connector
CN601: Discharge temperature (TD) sensor connector

<MCC-1571>

RAV-SP240AT2-UL, RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL


Fan motor output (Lower side) CN300 (White)
Fan motor output (Upper side) CN400 (White)
Compressor output terminal CN202 CN201 CN200
Electrolytic condenser
Case thermostat connector CN609 (Blue)
High pressure SW CN690 (Red)
Power supply circuit protective fuse F100 250V, 3.15A, Plastic case)
4-way valve connector CN701 (White)
Compressor ON output connector CN704 (Blue)
Heater output connector CN610 (Gray)
Outside input connector CN610 (Yellow)
Specific operation switch SW801 SW804
Display select switch SW800 SW803
Temp. sensor connector TL CN604 (White) TD CN603 (White) TO CN602 (Yellow) TE CN601 (White) TS CN600 (White)
Power-ON, error display LED D800 to 804 (Yellow) D805 (Green)
PMV connector CN710 (White)
Initial setting switch SW802
Indoor/Outdoor communication signal LED D503 (Green, Outdoor → Indoor) D502 (Orange, Indoor → Outdoor)
Lead wire for grounding P09 (Black)
Connector for reactor
Connector for reactor
Inter-unit cable connector CN04 (White)
Inter-unit cable protective fuse F03 (250V, 25A)
Power supply protective fuse F01 (250V, 25A)
4-way valve protective fuse F700 (250V, 3.15A, Plastic case)
Lead wire for connection of power supply P01 (Red) P02 (White)

7-2. Outline of Main Controls

RAV-SP180AT2-UL

1. PMV (Pulse Motor Valve) control

1) PMV is controlled between (20 to 500) pulsed during operation.
2) In cooling operation, PMV is usually controlled with the temperature difference between TS sensor and TC sensor aiming (2 to 5K) as the target value.
3) In heating operation, PMV is usually controlled with the temperature difference between TS sensor and TE sensor aiming (–2 to 4K) as the target value.
4) When the cycle excessively heated in both cooling and heating operation, PMV is controlled by TD sensor.
   The target value is 213.8°F (101°C) for both cooling and heating operations.

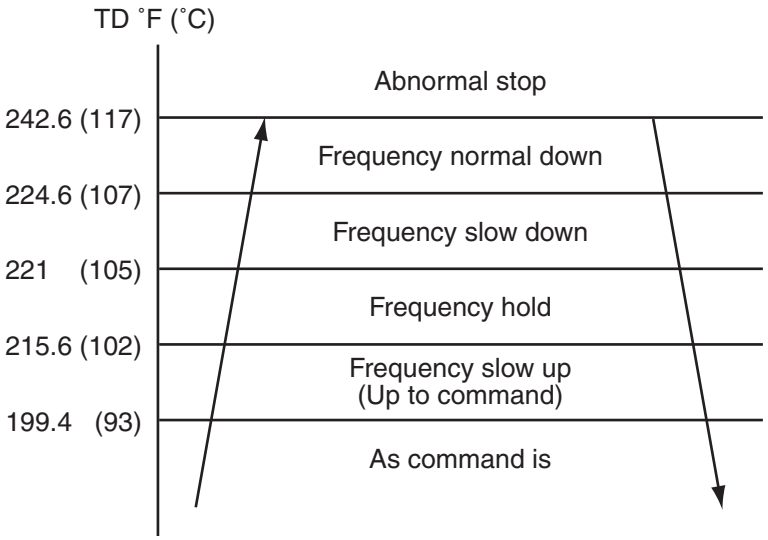
REQUIREMENT

A sensor trouble may cause a liquid back-flow or abnormal overheat resulting in excessive shortening of the compressor life.

In a case of trouble on the compressor, be sure to check there is no error in the resistance value or the refrigerating cycle of each sensor after repair and then start the operation.

2. Discharge temperature release control

1) When the discharge temperature did not fall or the discharge temperature rapidly went up by PMV control, this control lowers the operation frequency.
   It subdivides the frequency control up to 0.6Hz to stabilize the cycle.
2) When the discharge temperature detected an abnormal stop zone, the compressor stops and then restarts after 2 minutes 30 seconds.
   The error counting is cleared when the operation continued for A minutes. If the error is detected by B times without clearing, the error is determined and restarting is not performed.
   * The cause is considered as excessively little amount of refrigerant, PMV error or clogging of the cycle.
3) For displayed contents of error, confirm on the check code list.



	SP180
A	6
B	8

3. Outdoor fan control

Revolution frequency allocation of fan taps [rpm]

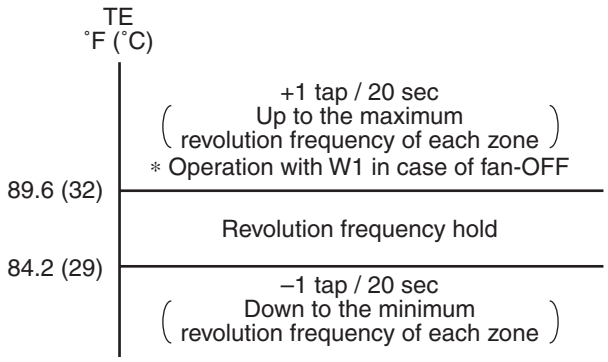
RAV-SP	W1	W2	W3	W4	W5	W6	W7	W8	W9	WA	WB	WC	WD	WE	WF
180AT2-UL	200	250	300	400	480	500	520	560	640	670	700	750	800	880	980

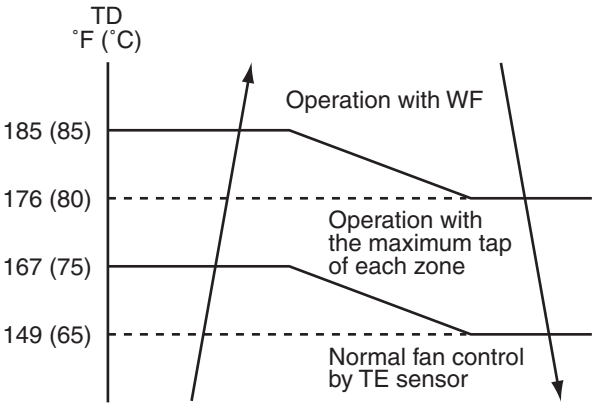
3-1) Cooling fan control

① The outdoor fan is controlled by TE sensor, TO sensor and the operation frequency. It is controlled by every 1 tap of DC fan control (15 taps).

② Only for 60 seconds after start-up of operation, it is fixed by the maximum fan tap corresponded to the zone in the following table, and then the fan is controlled by temperature of TE sensor.

③ When temperature of TD sensor became high sufficiently, it is controlled so that the fan revolution frequency will become higher ignoring TE sensor temperature.





Temp. range	20 Hz or lower		20Hz to 45Hz		45Hz or higher	
	Min.	Max.	Min.	Max.	Min.	Max.
100.4°F (38°C) ≤ TO	W6	WB	W7	WE	W9	WF
82.4°F (28°C) ≤ TO < 100.4°F (38°C)	W5	WA	W6	WD	W8	WE
59°F (15°C) ≤ TO < 82.4°F (28°C)	W3	W7	W4	W9	W6	WB
41.9°F (5.5°C) ≤ TO < 59°F (15°C)	W2	W5	W3	W7	W5	W9
32°F (0°C) ≤ TO < 41.9°F (5.5°C)	W1	W3	W2	W5	W3	W7
23°F (–5°C) ≤ TO < 32°F (0°C)	W1	W2	W1	W3	W2	W4
TO < 23°F (–5°C)	OFF	OFF	OFF	OFF	W1	W3
TO error	W1	WB	W1	WE	W1	WF

3-2) Heating fan control

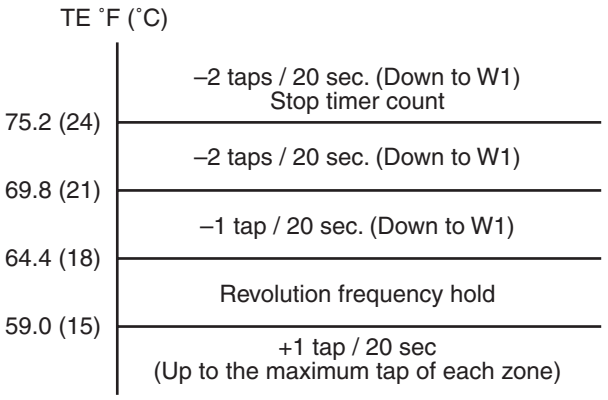
① The outdoor fan is controlled by TE sensor, TO sensor and the operation frequency.
(Control from minimum W1 to maximum (according to the following table))

② For 3 minutes after the operation has started, the maximum fan tap corresponding to the zone in the following table is fixed and then the fan is controlled by temperature of TE sensor.

③ When TE ≥ 75.2°F (24°C) continues for 5 minutes, the compressor stops.

It is the same status as the normal THERMO OFF without error display. The compressor restarts after approx. 2 minutes 30 seconds and this intermittent operation is not abnormal.

④ In case that the status in item ③ generates frequently, stain on filter of the suction part of the indoor unit is considered. Clean the filter and then restart the operation.

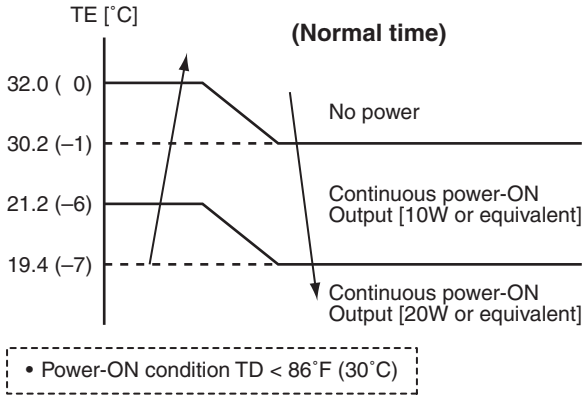

TE ˚F (˚C)
–2 taps / 20 sec. (Down to W1)
Stop timer count
75.2 (24)
–2 taps / 20 sec. (Down to W1)
69.8 (21)
–1 tap / 20 sec. (Down to W1)
64.4 (18)
Revolution frequency hold
59.0 (15)
+1 tap / 20 sec
(Up to the maximum tap of each zone)

Temp. range	20 Hz or lower	20Hz to 45Hz	45Hz or higher
	Max.	Max.	Max.
50°F (10°C) ≤ TO	W7	W8	W9
41.9°F (5.5°C) ≤ TO < 50°F (10°C)	WA	WC	WE
23°F (–5°C) ≤ TO < 41.9°F (5.5°C)	WD	WE	WF
TO < 23°F (–5°C)	WE	WF	WF
TO error	WE	WF	WF

4. Coil heating control

1) This control function heats the compressor by turning on the stopped compressor instead of a case heater. It purposes to prevent stagnation of the refrigerant inside of the compressor.
2) As usual, turn on power of the compressor for the specified time before a test run after installation; otherwise a trouble of the compressor may be caused.

   As same as a test run, it is recommended to turn on power of the compressor beforehand when starting operation after power of the compressor has been interrupted and left as it is for a long time.
3) Using TD sensor and TE sensor, RAV-SP180AT2-UL judges the power-on.
4) The power is turned off when TD is 86°F (30°C) or more.



REQUIREMENT

In some cases, the sound of power-ON may be heard. It is not abnormal.

REQUIREMENT

While heating the coil, the power sound may be heard. However it is not a trouble.

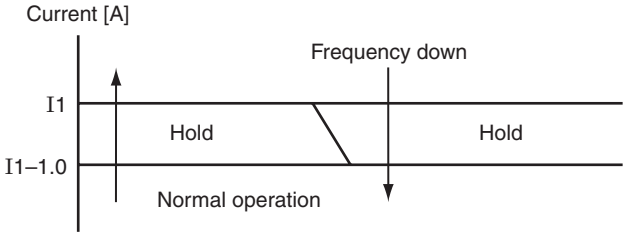
5. Short intermittent operation preventive control

1) For 3 to 10 minutes after operation start, in some cases, the compressor does not stop to protect the compressor even if receiving the THERMO OFF signal from indoor.

   However it is not abnormal status. (The operation continuance differs according to the operation status.)
2) When the operation stops by the remote controller, the operation does not continue.

6. Current release control

No. of revolutions of the compressor is controlled by AC current value detected by the outdoor P.C. board so that the input current of the inverter does not exceed the specified value.



Model	RAV-SP180AT2-UL	
	COOL	HEAT
I1 value [A]	10.80	13.05

7. Current release value shift control

1) This control purposes to prevent troubles of the electronic parts such as the compressor driving elements and the compressor during cooling operation.
2) The current release control value (I1) is selected from the following table according to TO sensor value.

Current release control value (I1)

[A]

Temperature range	RAV-SP180AT2-UL
122°F (50°C) ≤ TO	5.1
113°F (45°C) ≤ TO < 122°F (50°C)	5.1
102.2°F (39°C) ≤ TO < 113°F (45°C)	7.8
TO < 102.2°F (39°C)	10.8
TO error	5.1

8. Over-current protective control

1) When the over-current protective circuit detected an abnormal current, stop the compressor.
2) The compressor restarts after 2 minutes 30 seconds as setting [1] as an error count.
3) When the error count [8] was found, determine an error and restart operation is not performed.
4) For the error display contents, confirm on the check code list.

9. High-pressure SW control

1) The operation frequency is controlled to restrain abnormal rising of high pressure by the High-pressure SW.
2) When cooling operation detects abnormal pressure of the stop zone, stop the compressor and the error count becomes +1.
3) When the compressor stopped with 2), the compressor will restart only when the pressure lowers under the reset pressure after 2 minutes and 30 seconds.
4) The error count when the compressor stopped with 2) is cleared after the operation continued for 10 minutes.

   If the error count becomes [8] without clearing, the error is determined and reactivation is not performed.
5) For the error display contents, confirm on the check code list.

Pressure of High-pressure switch control

STOP pressure	601.8 $^{+0}_{-29}$ psi $\left(4.15\ ^{+0}_{-0.2}\ \text{MPa}\right)$
RESET pressure	464 ± 29 psi (3.20 ± 0.2 MPa)

10. Auto restart

1) Object

   It restarts the operation automatically after resetting the unexpected stop of power supply such as power failure.
2) Contents

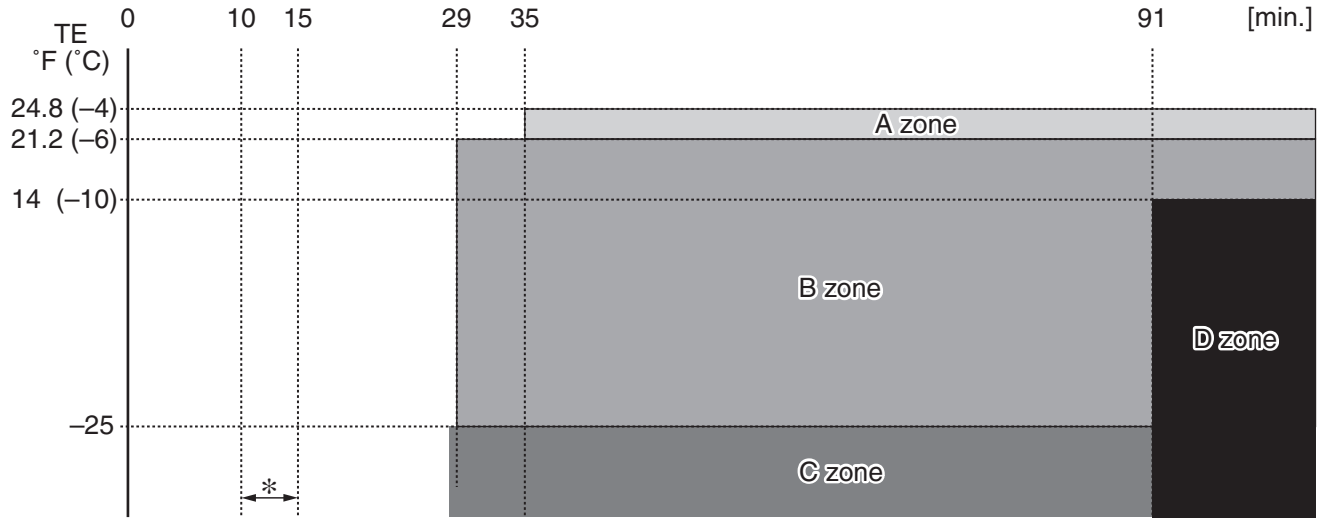
   After returning from a power failure, the auto restart function reads the operation status from EEPROM and then restarts the operation automatically according to the operation contents.
3) Setup of function exchange by wired remote controller CODE No. (DN): 28

SET DATA	0000	0001
Auto restart	None	Provided

11. Defrost control

1) In heating operation, defrost operation is performed when TE sensor satisfies any condition in A zone to D zone.
2) During defrosting operation, it finishes if TE sensor continued 53.6°F (12°C) or continued 41°F (5°C) ≤ TE < 53.6°F (12°C) for 80 seconds. The defrost operation also finishes when it continued for 15 minutes even if TE sensor temperature was 41°F (5°C) or lower.
3) After defrost operation was reset, the compressor stopped for approx. 40 seconds and then the heating operation starts.

Start of heating operation



* The minimum TE value and To value between 10 and 15 minutes after heating operation has started are stored in memory as TE0 and To0, respectively.

	In normal To	In abnormal To
A zone	When status (TE0 – TE) – (To0 – To) ≥ 37.4°F (3°C) continued for 20 seconds	When status (TE0 – TE) ≥ 37.4°F (3°C) continued for 20 seconds
B zone	When status (TE0 – TE) – (To0 – To) ≥ 36.5°F (2.5°C) continued for 20 seconds	When status (TE0 – TE) 36.5°F (2.5°C) continued for 20 seconds
C zone	When the status (TE ≤ –14.8°F (–26°C)) continued for 20 seconds	
D zone	When the status (TE ≤ 14°F (–10°C)) continued for 20 seconds	

RAV-SP240AT2-UL, RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL

1. PMV (Pulse Motor Valve) control

1) PMV is controlled between 30 and 500 pulsed during operation.
2) In cooling operation, PMV is usually controlled with the temperature difference between TS sensor and TC sensor aiming 1 to 4K as the target value.
3) In heating operation, PMV is usually controlled with the temperature difference between TS sensor and TE sensor aiming −1 to 4K (SP240: 2 to 4K) as the target value.
4) When the cycle excessively heated in both cooling and heating operation, PMV is controlled by TD sensor. The target value is usually 195.8°F (91°C) in cooling operation and 204.8°F (96°C) in heating operation.

REQUIREMENT

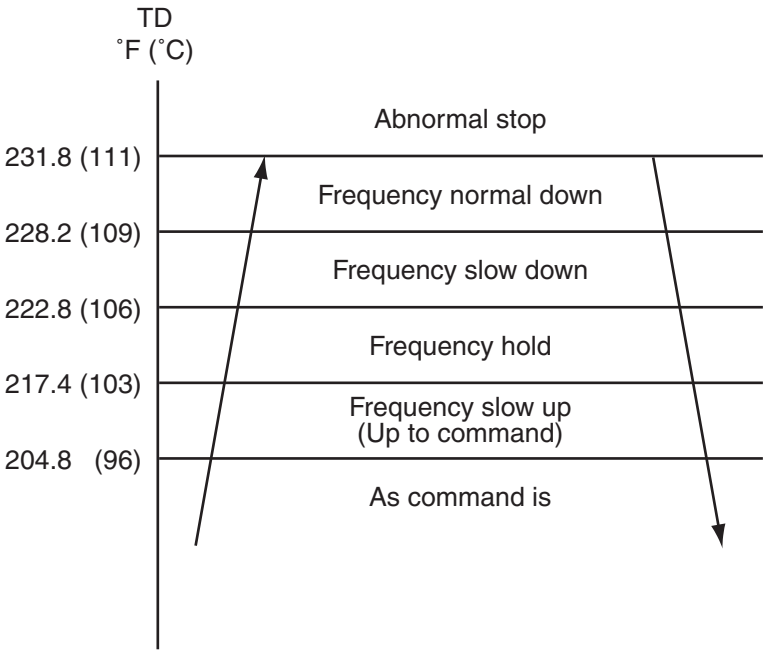
A sensor trouble may cause a liquid back-flow or abnormal overheat resulting in excessive shortening of the compressor life. In a case of trouble on the compressor, be sure to check there is no error in the resistance value or the refrigerating cycle of each sensor after repair and then start the operation.

2. Discharge temperature release control

1) When the discharge temperature did not fall or the discharge temperature rapidly went up by PMV control, this control lowers the operation frequency. It subdivides the frequency control up to 0.6Hz to stabilize the cycle.
2) When the discharge temperature detected an abnormal stop zone, the compressor stops and then restarts after 2 minutes 30 seconds.

   The error counting is cleared when the operation continued for 10 minutes. If the error is detected by 4 times without clearing, the error is determined and restarting is not performed.

   * The cause is considered as excessively little amount of refrigerant, PMV error or clogging of the cycle.
3) For displayed contents of error, confirm on the check code list.



3. Outdoor fan control

Revolution frequency allocation of fan taps [rpm]

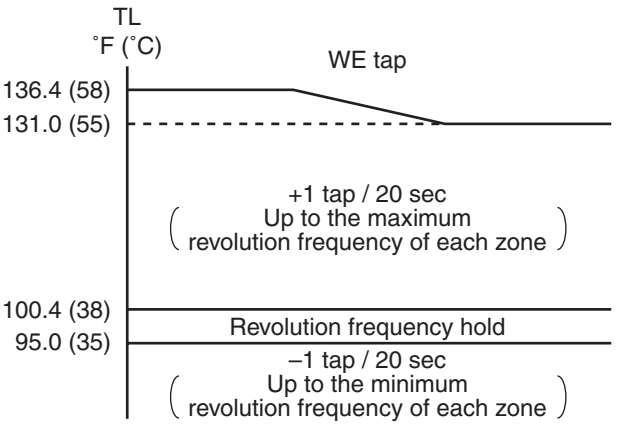
RAV-	W1	W2	W3	W4	W5	W6	W7	W8	W9	WA	WB	WC	WD	WE	WF
SP240AT2-UL	200	230	260	300	340	380	420	460	520	570	600	630	670	710	740

RAV-		W1	W2	W3	W4	W5	W6	W7	W8	W9	WA	WB	WC	WD	WE
SP300AT2-UL SP360AT2-UL SP420AT2-UL	Up	200	240	240	260	320	380	480	500	530	610	640	660	720	780
	Down	—	—	200	280	360	400	500	520	550	630	660	700	740	820

3-1) Cooling fan control

① The outdoor fan is controlled by TL sensor, TO sensor and the operation frequency. The outdoor fan is controlled by every 1 tap of DC fan control (SP240: 15 taps, SP300, SP360, SP400: 14 taps).

② Only for 60 seconds after the operation has started, the maximum fan tap corresponding to the zone in the following table is fixed and then the fan is controlled by temperature of TL sensor.



<RAV-SP240AT2-UL>

Temp. range	20 Hz or lower		20Hz to 45Hz		45Hz or higher	
	Min.	Max.	Min.	Max.	Min.	Max.
100.4°F (38°C) ≤ TO	W6	WC	W8	WE	WA	WE
84.2°F (29°C) ≤ TO < 100.4°F (38°C)	W5	WB	W7	WD	W9	WD
59°F (15°C) ≤ TO < 84.2°F (29°C)	W4	W8	W6	WA	W8	WC
41°F (5°C) ≤ TO < 59°F (15°C)	W3	W6	W5	W8	W7	WA
32°F (0°C) ≤ TO < 41°F (5°C)	W2	W4	W4	W6	W5	W8
24.8°F (–4°C) ≤ TO < 32°F (0°C)	W2	W3	W3	W5	W4	W6
TO < 24.8°F (–4°C)	OFF	OFF	OFF	W2	OFF	W3
TO error	OFF	WC	OFF	WE	OFF	WE

<RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL>

Temp. range	20 Hz or lower		20Hz to 45Hz		45Hz or higher	
	Min.	Max.	Min.	Max.	Min.	Max.
100.4°F (38°C) ≤ TO	W6	WC	W8	WC	WA	WE
84.2°F (29°C) ≤ TO < 100.4°F (38°C)	W5	WB	W7	WC*	W9	WC
59°F (15°C) ≤ TO < 84.2°F (29°C)	W4	W8	W6	WA	W8	WC
41°F (5°C) ≤ TO < 59°F (15°C)	W3	W6	W5	W8	W7	WA
32°F (0°C) ≤ TO < 41°F (5°C)	W2	W4	W4	W6	W5	W8
24.8°F (–4°C) ≤ TO < 32°F (0°C)	W2	W3	W3	W5	W4	W6
TO < 24.8°F (–4°C)	W1	W2	W1	W4	W2	W6
TO error	W1	WC	W1	WC	W2	WD

* : WB for SP300

3-2) Heating fan control

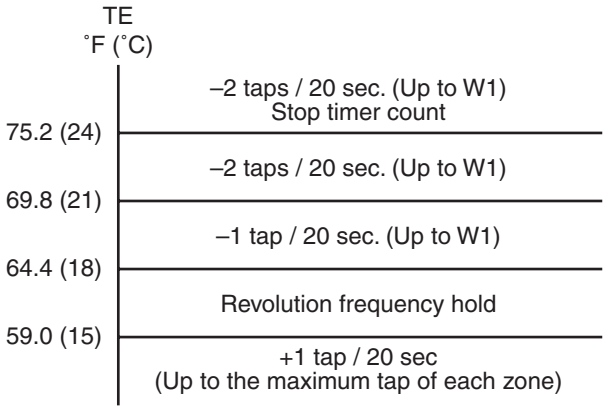
① The outdoor fan is controlled by TE sensor, TO sensor and the operation frequency. (Control from minimum W1 to maximum (according to the following table))

② For 3 minutes after the operation has started, the maximum fan tap corresponding to the zone in the following table is fixed and then the fan is controlled by temperature of TE sensor.

③ When TE ≥ 75.2°F (24°C) continues for 5 minutes, the compressor stops. It is the same status as the normal THERMO-OFF without error display.

The compressor restarts after approx. 2 minutes 30 seconds and this intermittent operation is not abnormal.

④ In case that the status in item ③ generates frequently, stain on filter of the suction part of the indoor unit is considered. Clean the filter and then restart the operation.


TE
˚F (˚C)
–2 taps / 20 sec. (Up to W1)
Stop timer count
75.2 (24)
–2 taps / 20 sec. (Up to W1)
69.8 (21)
–1 tap / 20 sec. (Up to W1)
64.4 (18)
Revolution frequency hold
59.0 (15)
+1 tap / 20 sec
(Up to the maximum tap of each zone)

Object: RAV-SP240AT2-UL

Temp. range	20 Hz or lower	20Hz to 45Hz	45Hz or higher
	Max.	Max.	Max.
50°F (10°C) ≤ TO	W7	W8	W9
41°F (5°C) ≤ TO < 50°F (10°C)	W9	WB	WD
26.6°F (–3°C) ≤ TO < 41°F (5°C)	WD	WD	WE
14°F (–10°C) ≤ TO < 26.6°F (–3°C)	WE	WE	WE
TO < 14°F (–10°C)	WF	WF	WF
TO error	WF	WF	WF

Object: RAV-SP300AT2-UL

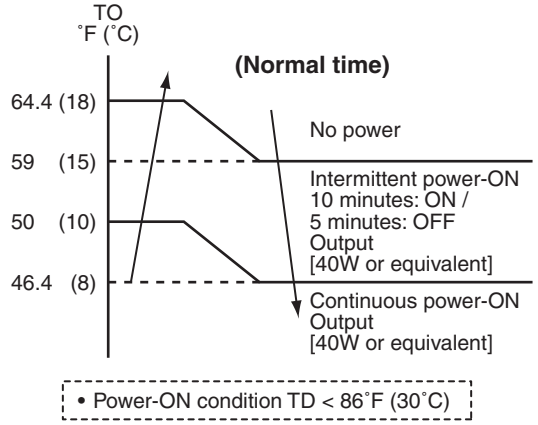
Temp. range	20 Hz or lower	20Hz to 45Hz	45Hz or higher
	Max.	Max.	Max.
50°F (10°C) ≤ TO	W7	W8	W9
41°F (5°C) ≤ TO < 50°F (10°C)	W9	WA	WA
26.6°F (–3°C) ≤ TO < 41°F (5°C)	WA	WA	WB
14°F (–10°C) ≤ TO < 26.6°F (–3°C)	WB	WB	WB
TO < 14°F (–10°C)	WD	WD	WD
TO error	WD	WD	WD

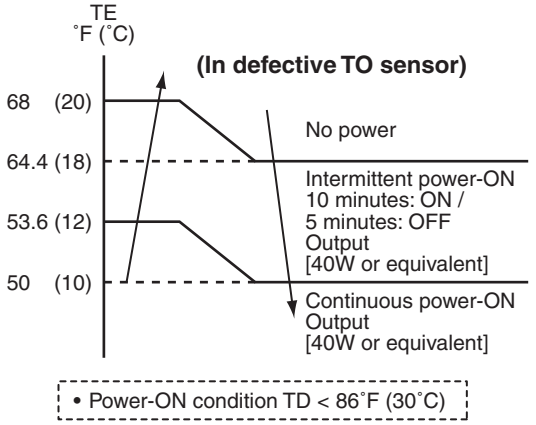
Object: RAV-SP360AT2-UL, RAV-SP420AT2-UL

Temp. range	20 Hz or lower	20Hz to 45Hz	45Hz or higher
	Max.	Max.	Max.
50°F (10°C) ≤ TO	W7	W8	W9
41°F (5°C) ≤ TO < 50°F (10°C)	W9	WA	WB
26.6°F (–3°C) ≤ TO < 41°F (5°C)	WB	WB	WC
14°F (–10°C) ≤ TO < 26.6°F (–3°C)	WC	WC	WC
TO < 14°F (–10°C)	WD	WD	WD
TO error	WD	WD	WD

4. Coil heating control

1) This control function heats the compressor by turning on the stopped compressor instead of a case heater.
   It purposes to prevent stagnation of the refrigerant inside of the compressor.
2) As usual, turn on power of the compressor for the specified time before a test run after installation; otherwise a trouble of the compressor may be caused.
   As same as a test run, it is recommended to turn on power of the compressor beforehand when starting operation after power of the compressor has been interrupted and left as it is for a long time.
3) A judgment for electricity is performed by TD and TO sensors.
   If TO sensor is defective, a backup control is automatically performed by TE sensor.
   For a case of defective TO sensor, judge it with outdoor LED display.
4) For every model, the power is turned off when TD is 86°F (30°C) or more.





REQUIREMENT

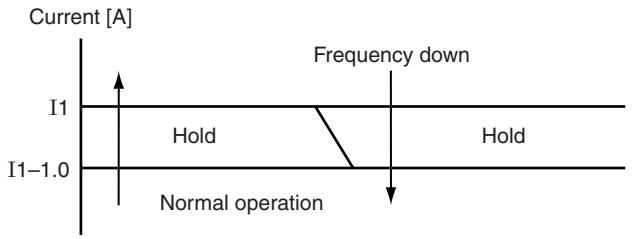
While heating the coil, the power sound may be heard. However it is not a trouble.

5. Short intermittent operation preventive control

1) For 3 to 10 minutes after operation start, in some cases, the compressor does not stop to protect the compressor even if receiving the thermostat-OFF signal from indoor.
   However it is not abnormal status. (The operation continuance differs according to the operation status.)
2) When the operation stops by the remote controller, the operation does not continue.

6. Current release control

No. of revolutions of the compressor is controlled by AC current value detected by T620 on the outdoor P.C. board so that the input current of the inverter does not exceed the specified value.



Objective model RAV-	SP240AT2-UL		SP300AT2-UL SP360AT2-UL SP420AT2-UL	
	COOL	HEAT	COOL	HEAT
I1 value [A]	16.0	20.0	20.0	20.0

7. Current release value shift control

1) This control purposes to prevent troubles of the electronic parts such as the compressor driving elements and the compressor during cooling operation.
2) The current release control value (I1) is selected from the following table according to TO sensor value.

Current release control value (I1)

[A]

Temperature range	RAV-SP300AT2-UL RAV-SP360AT2-UL RAV-SP420AT2-UL
111.2°F (44°C) ≤ To	15.0
102.2°F (39°C) ≤ To < 111.2°F (44°C)	17.7
To < 102.2°F (39°C)	20.0
TO error	15.0

8. Over-current protective control

1) When the over-current protective circuit detected an abnormal current, stop the compressor.
2) The compressor restarts after 2 minutes 30 seconds setting [1] as an error count.
3) When the error count [8] was found, determine an error and restart operation is not performed.
4) For the error display contents, confirm on the check code list.

9. High-pressure SW control

1) The operation frequency is controlled to restrain abnormal rising of high pressure by the High-pressure SW.
2) When cooling operation detects abnormal pressure of the stop zone, stop the compressor and the error count becomes +1.
3) When the compressor stopped with 2), the compressor will restart only when the pressure lowers under the reset pressure after 5 minutes.
4) The error count when the compressor stopped with 2) is cleared after the operation continued for 10 minutes.

   If the error count becomes [10] without clearing, the error is determined and reactivation is not performed.
5) For the error display contents, confirm on the check code list.

Pressure of High-pressure switch control

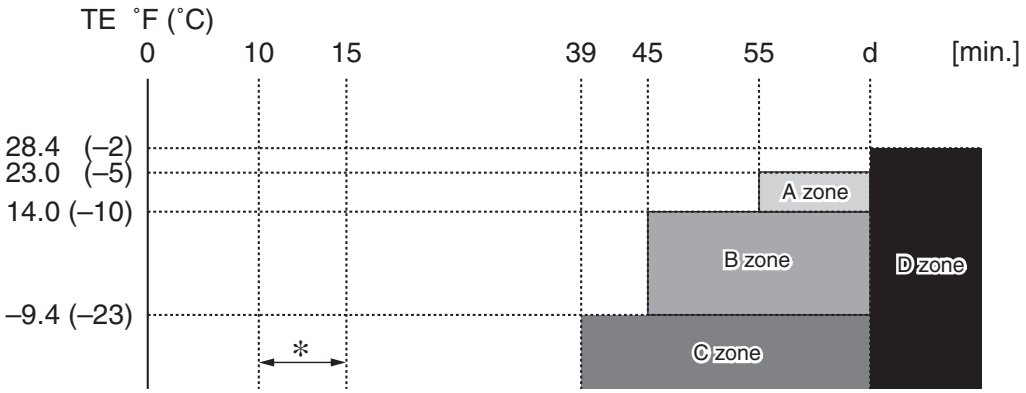
STOP pressure	601.8 $^{+0}_{-29}$ psi (4.15 $^{+0}_{-0.2}$ MPa)
RESET pressure	464 ± 29 psi (3.20 ± 0.2 MPa)

10. Defrost control

1) In heating operation, defrost operation is performed when TE sensor satisfies any condition in A zone to D zone.
2) During defrosting operation, it finishes if TE sensor continued 53.6°F (12°C) or higher for 3 seconds or continued 44.6°F (7°C) ≤ TE < 53.6°F (12°C) for 1 minute.

   The defrost operation also finishes when it continued for 10 minutes even if TE sensor temperature was 44.6°F (7°C) or lower.
3) After defrost operation was reset, the compressor stopped for approx. 40 seconds and then the heating operation starts.

Start of heating operation



* The minimum TE value and To value between 10 and 15 minutes after heating operation has started are stored in memory as TE0 and To0, respectively.

	In normal To	In abnormal To
A zone	When status (TE0 – TE) – (To0 – To) ≥ 37.4°F (3°C) continued for 20 seconds	When status (TE0 – TE) ≥ 37.4°F (3°C) continued for 20 seconds
B zone	When status (TE0 – TE) – (To0 – To) ≥ 35.6°F (2°C) continued for 20 seconds	When status (TE0 – TE) ≥ 35.6°F (2°C) continued for 20 seconds
C zone	When status (TE ≤ –9.4°F (–23°C)) continued for 20 seconds	
D zone	When compressor operation status of TE < 28.4°F (–2°C) is calculated by d portion	

4) The time of above d can be changed by exchanging jumper [J805] and [J806] of the outdoor control P.C. board.
(Setting at shipment: 150 minutes)

J805	J806	d
○	○	150 minutes Setting at shipment
○	×	90 minutes
×	○	60 minutes
×	×	30 minutes

○ : Short circuit, × : Open

11. Compressor protective control <RAV-SP240AT2-UL only>

1) This control purposes to raise the operation frequency until 45Hz for 2 minutes in order to protect the compressor (Prevention of oil accumulation in the refrigerating cycle) when the status that the operation frequency is 45Hz or less has continued for 10 hours was calculated.

   The operation frequency follows the normal indoor command after controlling.

2) Although the compressor may stop by THERMO-OFF control when the room temperature varies and then attains the set temperature by this control, it is not abnormal.

3) During this control works, if stopping the operation by the remote controller, the operation does not continue.

12. Auto restart

1) Object

   It restarts the operation automatically after resetting the unexpected stop of power supply such as power failure.

2) Contents

   After returning from a power failure, the auto restart function reads the operation status from EEPROM and then restarts the operation automatically according to the operation contents.

3) Setup of function exchange by wired remote controller CODE No. (DN): 28

SET DATA	0000	0001
Auto restart	None	Provided

8. TROUBLESHOOTING

8-1. Summary of Troubleshooting

<Wired remote controller type>

1. Before troubleshooting

1) Required tools/instruments
   - ⊕ and ⊖ screwdrivers, spanners, radio cutting pliers, nippers, push pins for reset switch
   - Tester, thermometer, pressure gauge, etc.
2) Confirmation points before check
   a) The following operations are normal.
      1. Compressor does not operate.
         - Is not 3-minutes delay (3 minutes after compressor OFF)?
         - Is not the outdoor unit in standby status though the remote controller reached the setup temperature?
         - Does not timer operate during fan operation?
         - Is not an overflow error detected on the indoor unit?
         - Is not outside high-temperature operation controlled in heating operation?
      2. Indoor fan does not rotate.
         - Does not cool air discharge preventive control work in heating operation?
      3. Outdoor fan does not rotate or air volume changes.
         - Does not high-temperature release operation control work in heating operation?
         - Does not outside low-temperature operation control work in cooling operation?
         - Is not defrost operation performed?
      4. ON/OFF operation cannot be performed from remote controller.
         - Is not the control operation performed from outside/remote side?
         - Is not automatic address being set up?
           (When the power is turned on at the first time or when indoor unit address setting is changed, the operation cannot be performed for maximum approx. 5 minutes after power-ON.)
         - Is not being carried out a test run by operation of the outdoor controller?
   b) Did you return the cabling to the initial positions?
   c) Are connecting cables of indoor unit and remote controller correct?

2. Troubleshooting procedure

When a trouble occurred, check the parts along with the following procedure.

Trouble → **Confirmation of check code display** → **Check defective position and parts.**

NOTE :

For cause of a trouble, power conditions or malfunction/erroneous diagnosis of microcomputer due to outer noise is considered except the items to be checked. If there is any noise source, change the cables of the remote controller to shield cables.

<Wireless remote controller type>

1. Before troubleshooting

1) Required tools/instruments
   - ⊕ and ⊖ screwdrivers, spanners, radio cutting pliers, nippers, etc.
   - Tester, thermometer, pressure gauge, etc.
2) Confirmation points before check
   a) The following operations are normal.
      1. Compressor does not operate.
         - Is not 3-minutes delay (3 minutes after compressor OFF)?
         - Is not the outdoor unit in standby status though the remote controller reached the setup temperature?
         - Does not timer operate during fan operation?
         - Is not an overflow error detected on the indoor unit?
         - Is not outside high-temperature operation controlled in heating operation?
      2. Indoor fan does not rotate.
         - Does not cool air discharge preventive control work in heating operation?
      3. Outdoor fan does not rotate or air volume changes.
         - Does not high-temperature release operation control work in heating operation?
         - Does not outside low-temperature operation control work in cooling operation?
         - Is not defrost operation performed?
      4. ON/OFF operation cannot be performed from remote controller.
         - Is not forced operation performed?
         - Is not the control operation performed from outside/remote side?
         - Is not automatic address being set up?
         - Is not being carried out a test run by operation of the outdoor controller?
   b) Did you return the cabling to the initial positions?
   c) Are connecting cables between indoor unit and receiving unit correct?

2. Troubleshooting procedure

(When the power is turned on at the first time or when indoor unit address setting is changed, the operation cannot be performed for maximum approx. 5 minutes after power-ON.)

When a trouble occurred, check the parts along with the following procedure.

Trouble → **Confirmation of lamp display (When 4-way air discharge cassette type wireless remote controller is connected)** → **Check defective position and parts.**

1) Outline of judgment

   The primary judgment to check where a trouble occurred in indoor unit or outdoor unit is performed with the following method.

Method to judge the erroneous position by flashing indication on the display part of indoor unit (sensors of the receiving unit)

The indoor unit monitors operating status of the air conditioner, and the blocked contents of self-diagnosis are displayed restricted to the following cases if a protective circuit works.

8-2. Troubleshooting

8-2-1. Outline of judgment

The primary judgment to check whether a trouble occurred in the indoor unit or outdoor unit is carried out with the following method.

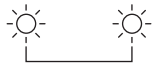
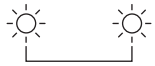
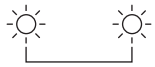
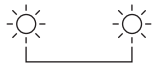
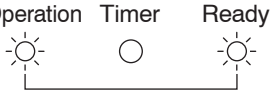
Method to judge the erroneous position by flashing indication on the display part of the indoor unit (sensors of the receiving part)

The indoor unit monitors the operating status of the air conditioner, and the blocked contents of self-diagnosis are displayed restricted to the following cases if a protective circuit works.

● : Go off, ○ : Go on, ☼ : Flash (0.5 sec.)

Lamp indication	Check code	Cause of trouble occurrence
Operation ● Timer ● Ready ● No indication at all	—	Power supply OFF or miswiring between receiving unit and indoor unit
Operation ☼ Timer ● Ready ● Flash	E01	Receiving error } Receiving unit } Miswiring or wire connection error between receiving unit and indoor unit
	E02	Sending error }
	E03	Communication stop }
	E08	Duplicated indoor unit No. } Setup error
	E09	Duplicated master units of remote controller }
	E10	Communication error between CPUs on indoor unit P.C. board
	E18	Wire connection error between indoor units, Indoor power OFF (Communication stop between indoor header and follower)
Operation ● Timer ● Ready ☼ Flash	E04	Miswiring between indoor unit and outdoor unit or connection erorr (Communication stop between indoor and outdoor units)
Operation ● Timer ☼ Ready ☼ Alternate flash	P10	Overflow was detected. } Protective device of indoor unit worked.
	P12	Indoor DC fan error }
Operation ☼ Timer ● Ready ☼ Alternate flash	P03	Outdoor unit discharge temp. error } Protective device of outdoor unit worked. ∗1
	P04	Outdoor high pressure system error }
	P05	Negative phase detection error } Outdoor unit error
	P07	Heat sink overheat error }
	P15	Gas leak detection error }
	P19	4-way valve system error (Indoor or outdoor unit judged.)
	P20	Outdoor unit high pressure protection
	P22	Outdoor unit: Outdoor unit error } Protective device of outdoor unit worked. ∗1
	P26	Outdoor unit: Inverter Idc operation }
	P29	Outdoor unit: Position detection error }
	P31	Stopped because of error of other indoor unit in a group (Check codes of E03/L03/L07/L08)

∗1: These are representative examples and the check code differs according to the outdoor unit to be combined.

Lamp indication	Check code	Cause of trouble occurrence
Operation Timer Ready  Alternate flash	F01 F02 P10	Heat exchanger sensor (TCJ) error Heat exchanger sensor (TC) error Heat exchanger sensor (TA) error } Indoor unit sensor error
Operation Timer Ready  Alternate flash	F04 F06 F07 F08 F12 F13 F15	Discharge temp. sensor (TD) error Temp. sensor (TE) error Temp. sensor (TL) error Temp. sensor (TO) error Temp. sensor (TS) error Temp. sensor (TH) error Temp. Sensor miswiring (TE, TS) } Sensor error of outdoor unit ∗1
Operation Timer Ready  Simultaneous flash	F29	Indoor EEPROM error
Operation Timer Ready  Simultaneous flash	F31	Outdoor EEPROM error
Operation Timer Ready Flash	H01 H02 H03 H04 H06	Compressor break down Compressor lock Compressor wiring error Current detection circuit error Case thermostat worked. } Outdoor compressor system error ∗1 Outdoor unit low pressure system error
Operation Timer Ready Simultaneous flash	L03 L07 L08 L09	Duplicated header indoor units There is indoor unit of group connection in individual indoor unit. Unsetting of group address } → AUTO address * If group construction and address are not normal when power supply turned on, automatically goes to address setup mode. Missed setting (Unset indoor capacity)
Operation Timer Ready  Simultaneous flash	L10 L20 L29 L30 L31	Unset model type (Service board) Duplicated indoor central addresses Outdoor unit and other error Outside interlock error Negative phase error } Others

∗1: These are representative examples and the check code differs according to the outdoor unit to be combined.

8-2-2. Others (Other than Check Code)

Lamp indication	Check code	Cause of trouble occurrence
Operation Timer Ready Simultaneous flash	—	During test run
Operation Timer Ready ○ Alternate flash	—	Disagreement of cool/heat (Automatic cool/heat setting to automatic cool/heat prohibited model)

8-2-3. Check Code List (Outdoor)

○ : Go on, ◎ : Flash, ● : Go off

ALT (Alternate): Alternate flashing when there are two flashing LED SIM (Simultaneous): Simultaneous flashing when there are two flashing LED

Remote controller indication	Sensor lamp part				Representative defective position	Detection	Explanation of error contents	Automatic reset	Operation continuation
	Block indication								
	Operation	Timer	Ready	Flash					
F04	◎	◎	○	ALT	Outdoor unit Discharge temp. sensor (TD) error	Outdoor	Open/Short of discharge temp. sensor was detected.	×	×
F06	◎	◎	○	ALT	Outdoor unit Temp. sensor (TE, TS, TL) error	Outdoor	Open/Short of heat exchanger temp. sensor was detected. Miswiring between TE sensor and TS sensor	×	×
F08	◎	◎	○	ALT	Outdoor unit Outside temp. sensor (TO) error	Outdoor	Open/Short of outside temp. sensor was detected.	○	○
F07	◎	◎	○	ALT	Outdoor unit Temp. sensor (TL) error	Outdoor	Open/Short of heat exchanger temp. sensor was detected.	×	×
F12	◎	◎	○	ALT	Outdoor unit Temp. sensor (TS) error	Outdoor	Open/Short of suction temp. sensor was detected.	×	×
F13	◎	◎	○	ALT	Outdoor unit Temp. sensor (TH) error	Outdoor	Open/Short of heat sink temp. sensor (Board installed) was detected.	×	×
F15	◎	◎	○	ALT	Outdoor unit Misconnection of temp. sensor (TE, TS)	Outdoor	Misconnection of outdoor heat exchanger temp. sensor and suction temp. sensor was detected.	×	×
F31	◎	◎	○	SIM	Outdoor unit EEPROM error	Outdoor	Outdoor P.C. board part (EEPROM) error was detected.	×	×
H01	●	◎	●		Outdoor unit Compressor break down	Outdoor	When reached min-Hz by current release control, short-circuited current (Idc) after DC excitation was detected.	×	×
H02	●	◎	●		Outdoor unit Compressor lock	Outdoor	Compressor lock was detected.	×	×
H03	●	◎	●		Outdoor unit Current detection circuit error	Outdoor	Current detection circuit error	×	×
H04	●	◎	●		Outdoor unit Case thermostat operation	Outdoor	Case thermostat operation was detected.	×	×
L10	◎	○	◎	SIM	Outdoor unit Setting error of service P.C. board type	Outdoor	When outdoor service P.C. board was used, model type select jumper setting was inappropriate.	×	×
L29	◎	○	◎	SIM	Outdoor unit Other outdoor unit error	Outdoor	1) Defective parts on outdoor P.C. board (MCU communication, EEPROM, TH sensor error) 2) When outdoor service P.C. board was used, model type selection was inappropriate. 3) Other error (Heat sink abnormal overheat, gas leak, 4-way valve inverse error) was detected.	×	×
P03	◎	●	◎	ALT	Outdoor unit Discharge temp. error	Outdoor	Error was detected by discharge temp. release control.	×	×
P04	◎	●	◎	ALT	Outdoor unit High pressure system error, Power supply voltage error	Outdoor	When case thermostat worked or High-pressure SW worked error was detected by high release control from indoor/outdoor heat exchanger temp. sensor. Power supply voltage error	×	×
P05	◎	●	◎	ALT	Power supply error	Outdoor	Power supply voltage error	×	×
P07	◎	●	◎	ALT	Outdoor unit Heat sink overheat	Outdoor	Abnormal overheat was detected by outdoor heat sink temp. sensor.	×	×
P15	◎	●	◎	ALT	Gas leak detection	Outdoor	Abnormal overheat of discharge temp. or suction temp. was detected.	×	×
P20	◎	●	◎	ALT	Outdoor unit High pressure system error	Outdoor	Error was detected by high release control from indoor/outdoor heat exchanger temp. sensor.	×	×
P22	◎	●	◎	ALT	Outdoor unit Outdoor fan error	Outdoor	Error (Over-current, lock, etc.) was detected on outdoor fan drive circuit.	×	×
P26	◎	●	◎	ALT	Outdoor unit Inverter Idc operation	Outdoor	Short-circuited protective operation of compressor drive circuit element (G-Tr /IGBT) worked.	×	×
P29	◎	●	◎	ALT	Outdoor unit Position detection error	Outdoor	Position detection error of compressor motor was detected.	×	×
E01	◎	●	●		No remote controller master unit Remote controller communication error	Remote controller	Signal was not received from indoor unit. Main remote controller was not set. (including 2 remote controllers)	—	—
E02	◎	●	●		Remote controller send error	Remote controller	Signal cannot be sent to indoor unit.	—	—
E03	◎	●	●		Regular communication error between indoor and remote controller	Indoor	No communication from remote controller and network adapter	○	×
E04	●	●	◎		Indoor/Outdoor serial error	Indoor	Serial communication error between indoor and outdoor	○	×
E08	◎	●	●		Duplicated indoor addresses ✧	Indoor	Same address as yours was detected.	○	
E09	◎	●	●		Duplicated main remote controllers	Remote controller	In 2-remote controller control, both were set as master. (Indoor header unit stops warning and follower unit continues operation.)	×	×
E10	◎	●	●		Communication error between CPU	Indoor	MCU communication error between main motor and micro computer	○	△
E18	◎	●	●		Regular communication error between header and follower indoor units	Indoor	Regular communication was impossible between master and follower indoor units.	○	×
L03	◎	●	◎	SIM	Duplicated indoor header units ✧	Indoor	There are multiple header units in a group.	×	×
L07	◎	●	◎	SIM	There is group cable in individual indoor unit. ✧	Indoor	When even one group connection indoor unit exists in individual indoor unit	×	×
L08	◎	●	◎	SIM	Unset indoor group address ✧	Indoor	Indoor address group was unset.	×	×
L09	◎	●	◎	SIM	Unset indoor capacity	Indoor	Capacity of indoor unit was unset.	×	×
L30	◎	○	◎	SIM	Outside error input to indoor unit (Interlock)	Indoor	Abnormal stop by CN80 outside error input	×	×
P19	◎	●	◎	ALT	4-way valve inverse error	Indoor Outdoor	In heating operation, error was detected by temp. down of indoor heat exchanger or temp. up ofTE, TS.	○	×

✧ When this warning was detected before group construction/address check finish at power supply was turned on, the mode shifts automatically to AUTO address setup mode.

○ : Go on, ◎ : Flash, ● : Go off
ALT (Alternate): Alternate flashing when there are two flashing LED SIM (Simultaneous): Simultaneous flashing when there are two flashing LED

Remote controller indication	Sensor lamp part				Representative defective position	Detection	Explanation of error contents	Automatic reset	Operation continuation
	Block indication								
	Operation	Timer	Ready	Flash					
F01	◎	◎	●	ALT	Indoor unit Heat exchanger sensor (TCJ) error	Indoor	Open/Short of heat exchanger (TCJ) was detected.	○	×
F02	◎	◎	●	ALT	Indoor unit Heat exchanger sensor (TC) error	Indoor	Open/Short of heat exchanger (TC) was detected.	○	×
F10	◎	◎	●	ALT	Indoor unit Room temp. sensor (TA) error	Indoor	Open/Short of room temp. (TA) was detected.	○	×
F29	◎	◎	●	SIM	Indoor unit Other indoor P.C. board error	Indoor	EEPROM error (Other error may be detected. If no error, automatic address is repeated.	×	×
P01	●	◎	◎	ALT	Indoor unit Indoor fan error	Indoor	Indoor AC fan error was detected. (Fan thermal relay worked.)	×	×
P10	●	◎	◎	ALT	Indoor unit Overflow detection	Indoor	Float switch worked.	×	×
P12	●	◎	◎	ALT	Indoor unit Indoor fan error	Indoor	Indoor fan error (Over-current / Lock, etc.) was detected.	×	×
P31	◎	●	◎	ALT	Other indoor unit error	Indoor	Other indoor under condition of warning in group. E03/L07/L03/L08 warning	○	×

Error mode detected by indoor unit

Operation of diagnostic function				Judgment and measures
Check code	**Cause of operation**	**Status of air conditioner**	**Condition**	
E03	No communication from remote controller (including wireless) and communication adapter	Stop (Automatic reset)	Displayed when error is detected	1. Check wires of remote controller and communication adapters. • Remote controller LCD display OFF (Disconnection) • Central remote controller [97] check code
E04	The serial signal is not output from outdoor unit to indoor unit. • Miswiring of inter-unit wire • Defective serial sending circuit on outdoor P.C. board • Defective serial receiving circuit on indoor P.C. board	Stop (Automatic reset)	Displayed when error is detected	1. Outdoor unit does not completely operate. • Inter-unit wire check, correction of miswiring • Check outdoor P.C. board. Correct wiring of P.C. board. • Check case tharmostat operation. (SP180 only) 2. When outdoor unit normally operates Check P.C. board (Indoor receiving / Outdoor sending).
E08	Duplicated indoor unit address	Stop	Displayed when error is detected	1. Check whether remote controller connection (Group/Individual) was changed or not after power supply turned on (Finish of group construction/Address check). * If group construction and address are not normal when the power has been turned on, the mode automatically shifts to address setup mode. (Resetting of address)
L03	Duplicated indoor header unit			
L07	There is group wire in individual indoor unit.			
L08	Unset indoor group address			
L09	Unset indoor capacity	Stop	Displayed when error is detected	1. Set indoor capacity (DN=11)
L30	Abnormal input of outside interlock	Stop	Displayed when error is detected	1. Check outside devices. 2. Check indoor P.C. board.
P10	Float switch operation • Float circuit, Disconnection, Coming-off, Float switch contact error	Stop	Displayed when error is detected	1. Trouble of drain pump 2. Clogging of drain pump 3. Check float switch. 4. Check indoor P.C. board.
P12	Indoor DC fan error	Stop	Displayed when error is detected	1. Position detection error 2. Over-current protective circuit of indoor fan driving unit operated. 3. Indoor fan locked. 4. Check indoor P.C. board.
P19	4-way valve system error • After heating operation has started, indoor heat exchangers temp. is down.	Stop (Automatic reset)	Displayed when error is detected	1. Check 4-way valve. 2. Check 2-way valve and check valve. 3. Check indoor heat exchanger (TC/TCJ). 4. Check indoor P.C. board.
P31	Own unit stops while warning is output to other indoor units.	Stop (Follower unit) (Automatic reset)	Displayed when error is detected	1. Judge follower unit while header unit is [E03], [L03], [L07] or [L08]. 2. Check indoor P.C. board.
F01	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TCJ)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TCJ). 2. Check indoor P.C. board.
F02	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TC)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TC). 2. Check indoor P.C. board.
F10	Coming-off, disconnection or short of indoor heat exchanger temp. sensor (TA)	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor heat exchanger temp. sensor (TA). 2. Check indoor P.C. board.
F29	Indoor EEPROM error • EEPROM access error	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor EEPROM. (including socket insertion) 2. Check indoor P.C. board.
E10	Communication error between indoor MCU • Communication error between fan driving MCU and main MCU	Stop (Automatic reset)	Displayed when error is detected	1. Check indoor P.C. board.
E18	Regular communication error between indoor header and follower units and between main and sub units	Stop (Automatic reset)	Displayed when error is detected	1. Check remote controller wiring. 2. Check indoor power supply wiring. 3. Check indoor P.C. board.

Error mode detected by outdoor unit

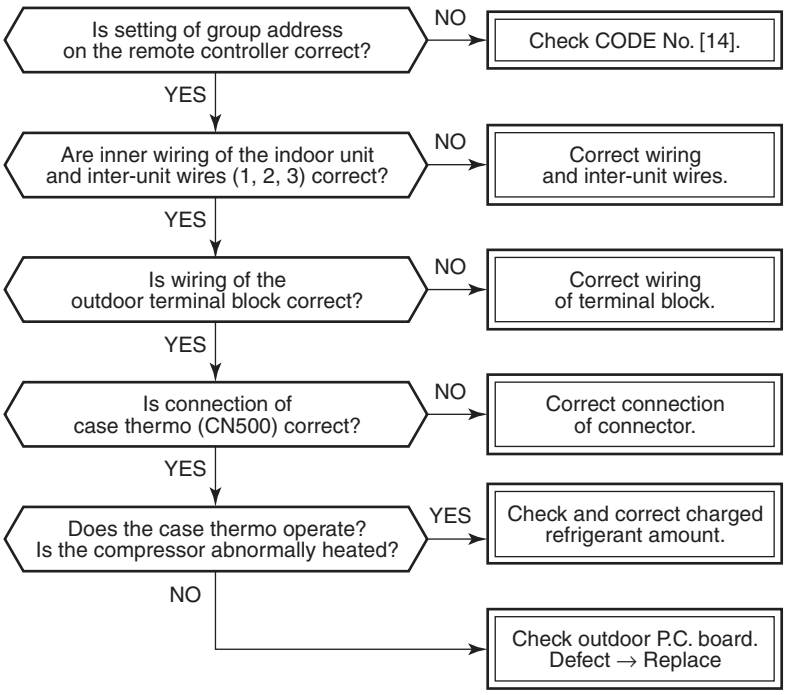
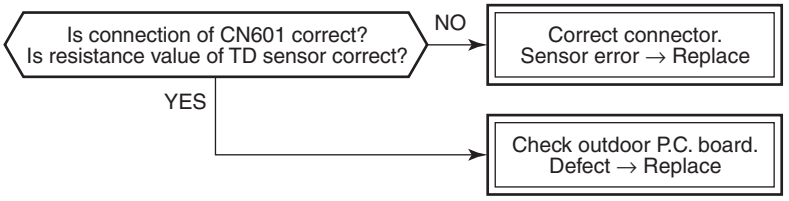
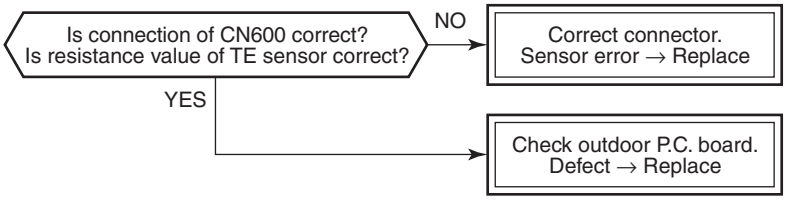
Operation of diagnostic function					Judgment and measures
Check code		Cause of operation	Status of air conditioner	Condition	
Indoor unit					
Under Ceiling	4-Way High Wall				
F04	F04	Disconnection, short of discharge temp. sensor (TD)	Stop	Displayed when error is detected	1. Check discharge temp. sensor (TD). 2. Check outdoor P.C. board.
F06	F06	Disconnection, short of outdoor temp. sensor (TE)	Stop	Displayed when error is detected	1. Check temp. sensor (TE). 2. Check outdoor P.C. board.
	F07	Disconnection, short of outdoor temp. sensor (TL)	Stop	Displayed when error is detected	1. Check temp. sensor (TL). 2. Check outdoor P.C. board.
	F12	Disconnection, short of suction temp. sensor (TS)	Stop	Displayed when error is detected	1. Check suction temp. sensor (TS). 2. Check outdoor P.C. board.
	F15	Miss-mounting of outdoor temp. sensor (TE, TS)	Stop	Displayed when error is detected	1. Check temp. sensor (TE, TS). 2. Check outdoor P.C. board.
F08	F08	Disconnection, short of outside temp. sensor (TO)	Continue	Displayed when error is detected	1. Check outside temp. sensor (TO). 2. Check outdoor P.C. board.
L29	F13	Disconnection, short of heat sink temp. sensor (TH)	Stop	Displayed when error is detected	1. Check outdoor P.C. board.
	F31	Outdoor P.C. EEPROM error	Stop	Displayed when error is detected	1. Check outdoor P.C. board.
	L10	Unset jumper of service P.C. board	Stop	Displayed when error is detected	1. Outdoor service P.C. board Check model type setting jumper wire.
	L29	Communication error between outdoor P.C. board MCU	Stop	Displayed when error is detected	1. Check outdoor P.C. board.
	P07	Heat sink overheat error * Heat sink temp. sensor detected over specified temperature.	Stop	Displayed when error is detected	1. Check screw tightening between PC. Board and heat sink and check radiator grease. 2. Check heat sink blast path.
	P15	Detection of gas leak * Discharge temp. sensor (TD), Suction temp. sensor (TS) detected temperature over specified temp.	Stop	Displayed when error is detected	1. Check gas leak, recharge 2. Check full open of service valve. 3. Check PMV (Pulse Motor Valve). 4. Check broken pipe. 5. Check discharge temp. sensor (TD), suction temp. sensor (TS).
	P19	4-way valve inverse error * After heating operation has started, indoor heat exchanger temp. lowers under the specified temp. * After heating operation has started, outdoor heat exchanger / suction temp. rises over the specified temp.	Stop	Displayed when error is detected	1. Check operation of 4-way valve. 2. Check outdoor heat exchanger (TE), suction temp. sensor (TS). 3. Check indoor heat exchanger sensor (TC). 4. Check 4-way valve coil. 5. Check PMV (Pulse Motor Valve).
H01	H01	Compressor break down * Although operation has started, operation frequency decreases and operation stops.	Stop	Displayed when error is detected	1. Check power supply voltage. (AC187, 253V) 2. Overload operation of refrigerating cycle. 3. Wiring error of compressor (Open phase)
H02	H02	Compressor lock * Over-current detection after compressor start-up	Stop	Displayed when error is detected	1. Trouble of compressor (Lock, etc.): Replace compressor. 2. Wiring error of compressor (Open phase)
H03	H03	Current detection circuit error	Stop	Displayed when error is detected	1. Check outdoor P.C. board. (AC current detection circuit)

Operation of diagnostic function					Judgment and measures
Check code		Cause of operation	Status of air conditioner	Condition	
Indoor unit					
Under Ceiling	4-Way High Wall				
P03	P03	Discharge temp. error * Discharge temp. (TD) over specified value was detected.	Stop	Displayed when error is detected	1. Check refrigerating cycle (Gas leak) 2. Trouble of electronic expansion valve 3. Check discharge temp. sensor (TD).
P04	H04	Case thermostat operation * Abnormal overheat of compressor	Stop	Displayed when error is detected	1. Check case thermostat and connector. 2. Check gas leak, recharge 3. Check full open of service valve. 4. Check PMV (Pulse Motor Valve). 5. Check broken pipe.
	P04	High-pressure SW error	Stop	Displayed when error is detected	• Check full-open of service valve. • Check outdoor fan error. • Check outdoor fan motor error. • Check clogging of outdoor PMV. • Check loading of indoor/outdoor heat exchangers. • Short-circuit of outdoor discharge/suction air • Check outdoor P.C. board (I/F) error. • Check error of fan system (air volume drop) at indoor side. • Check miswiring of communication line between indoor and outdoor. • Check overcharge of refrigerant.
	P05	Power supply voltage error	Stop	Displayed when error is detected	1. Check power supply voltage. AC198 to 253V
	P20	High pressure protective operation • During cooling operation, outdoor temp. sensor (TL) detected temperature over specified temp. • During heating operation, indoor temp. sensor (TC, TCJ) detected temperature over specified temp.	Stop	Displayed when error is detected	1. Check outdoor heat exchanger sensor (TL). 2. Check indoor heat exchanger sensor (TC, TCJ). 3. Check full open of service valve. 4. Check indoor/outdoor fan. 5. Check PMV (Pulse Motor Valve). 6. Check clogging and short circuit of indoor/outdoor heat exchanger. 7. Overcharge of refrigerant. Recharge
P22	P22	Outdoor fan system error	Stop	Displayed when error is detected	1. Check lock of fan motor. 2. Check power supply voltage. AC198 to 253V 3. Check outdoor P.C. board.
P26	P26	Short-circuit error of compressor driving element	Stop	Displayed when error is detected	1. When performing operation while taking-off compressor wire, P26 error occurs. Check control P.C. board. 2. When performing operation while taking-off compressor wire, an error does not occur. (Compressor rare short)
P29	P29	Position detection circuit error	Stop	Displayed when error is detected	1. Check control P.C. board.

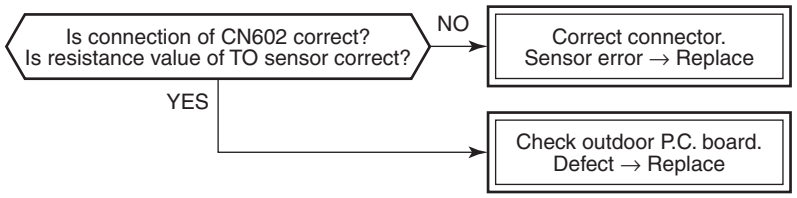
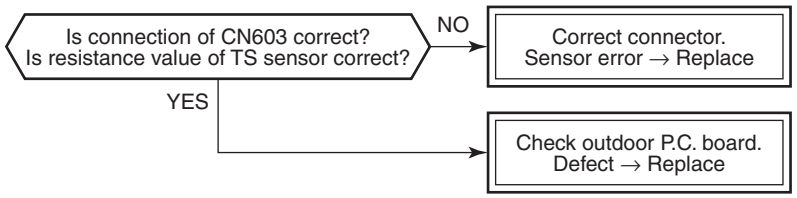
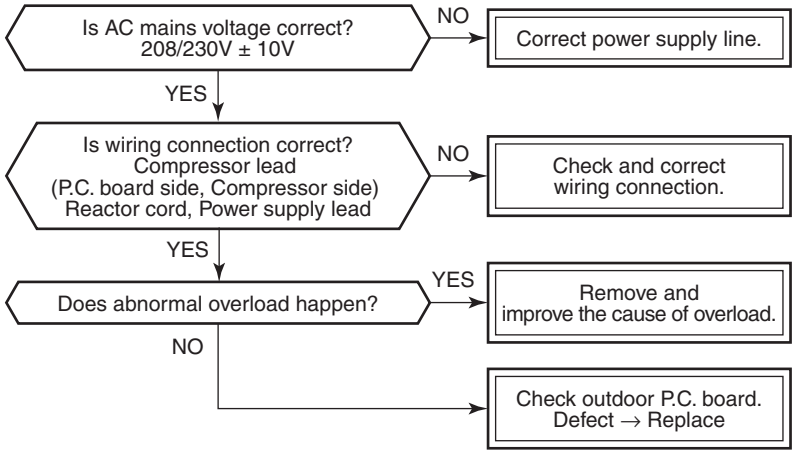
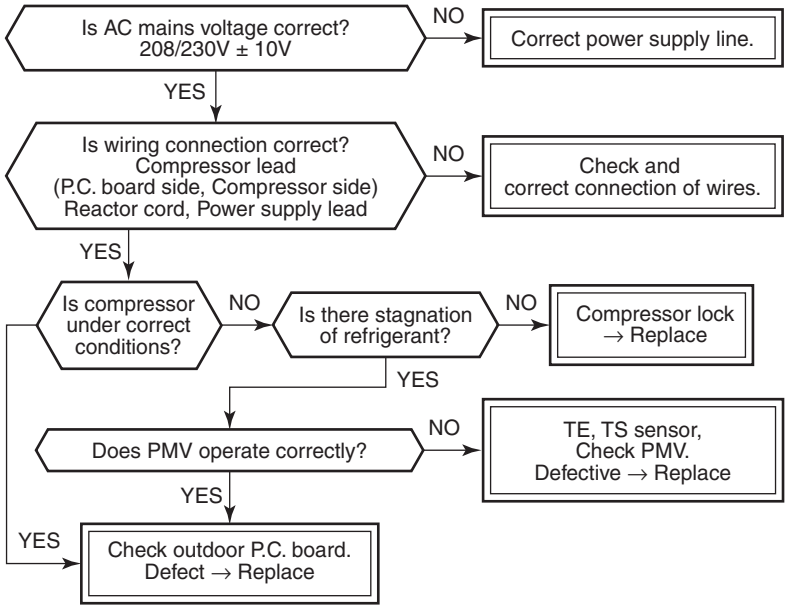
8-2-4. Diagnostic Procedure for Each Check Code (Outdoor Unit)

RAV-SP180AT2-UL

1) This section describes the diagnostic method for each check code displayed on the wired remote controller.
2) When "APPLICATION CONTROL KIT" (TCB-PCOS1UL) sold separately is connected, the error contents can be judged by LED on the APPLICATION CONTROL KIT. In this case, turn off both bit 1 and 2 of DIP switch 01 on the All-purpose control kit.

<table>
<tr><th>CODE No.</th><th>APPLICATION CONTROL KIT LED display</th><th>Check / Countermeasures
(Part without special mention indicates a part of the outdoor unit.)</th></tr>
<tr><td>[E04]</td><td>—</td><td>[Indoor / Outdoor communication error]
 
</td></tr>
<tr><td>[F04]</td><td>D01 (Red) ○
D02 (Yellow) ○
D03 (Yellow) ●
D04 (Yellow) ●</td><td>[Discharge temp. sensor (TD) error]
 
</td></tr>
<tr><td>[F06]</td><td colspan="2">∗ There is a possibility that any of the following items is not correct.
Checking LED on the APPLICATION CONTROL KIT enables you to judge what is incorrect.</td></tr>
<tr><td></td><td>D01 (Red) ○
D02 (Yellow) ●
D03 (Yellow) ●
D04 (Yellow) ●</td><td>[Heat exchanger temp. sensor (TE) error]
 
</td></tr>
<tr><td></td><td>D01 (Red) ●
D02 (Yellow) ●
D03 (Yellow) ○
D04 (Yellow) ●</td><td>[Suction temp. sensor (TS) error] → Refer to column of [F12].</td></tr>
</table>

LED display legend: ● Go off, ○ Go on, ◎ Flash (5Hz)

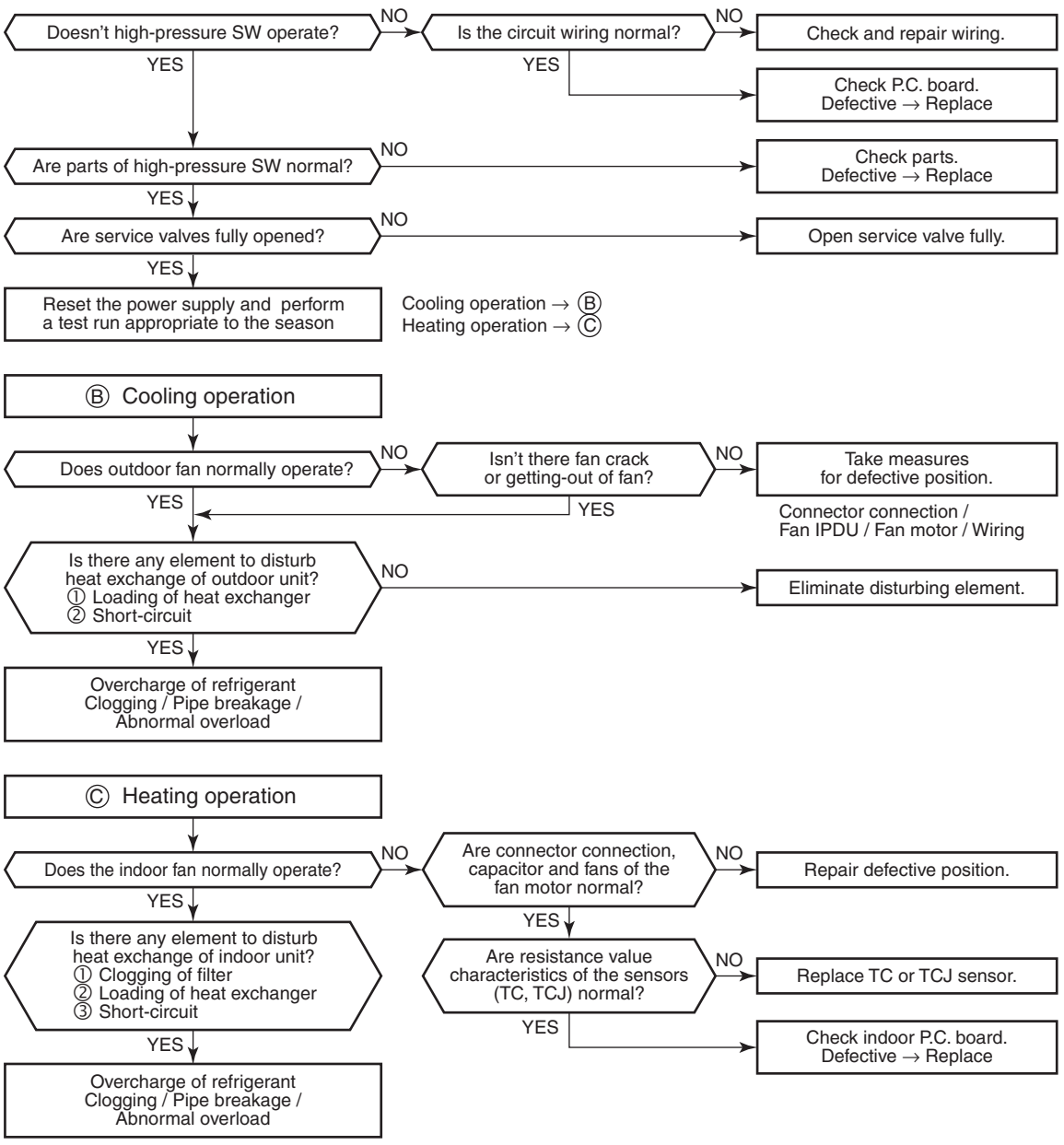
CODE No.	APPLICATION CONTROL KIT LED display	Check / Countermeasures (Part without special mention indicates a part of the outdoor unit.)
[F08]	D01 (Red) ● D02 (Yellow) ○ D03 (Yellow) ● D04 (Yellow) ●	**[Outside temp. sensor (TO) error]**  Is connection of CN602 correct? Is resistance value of TO sensor correct? NO Correct connector. Sensor error → Replace YES Check outdoor P.C. board. Defect → Replace
[F12]	D01 (Red) ● D02 (Yellow) ● D03 (Yellow) ○ D04 (Yellow) ●	**[Suction temp. sensor (TS) error]**  Is connection of CN603 correct? Is resistance value of TS sensor correct? NO Correct connector. Sensor error → Replace YES Check outdoor P.C. board. Defect → Replace
[H01]	D01 (Red) ◎ D02 (Yellow) ● D03 (Yellow) ◎ D04 (Yellow) ●	**[Compressor breakdown]**  Is AC mains voltage correct? 208/230V ± 10V NO Correct power supply line. YES Is wiring connection correct? Compressor lead (P.C. board side, Compressor side) Reactor cord, Power supply lead NO Check and correct wiring connection. YES Does abnormal overload happen? YES Remove and improve the cause of overload. NO Check outdoor P.C. board. Defect → Replace
[H02]	D01 (Red) ● D02 (Yellow) ● D03 (Yellow) ◎ D04 (Yellow) ●	**[Compressor lock]**  Is AC mains voltage correct? 208/230V ± 10V NO Correct power supply line. YES Is wiring connection correct? Compressor lead (P.C. board side, Compressor side) Reactor cord, Power supply lead NO Check and correct connection of wires. YES Is compressor under correct conditions? NO Is there stagnation of refrigerant? NO Compressor lock → Replace YES Does PMV operate correctly? NO TE, TS sensor, Check PMV. Defective → Replace YES YES Check outdoor P.C. board. Defect → Replace

LED display legend: ● Go off, ○ Go on, ◎ Flash (5Hz)

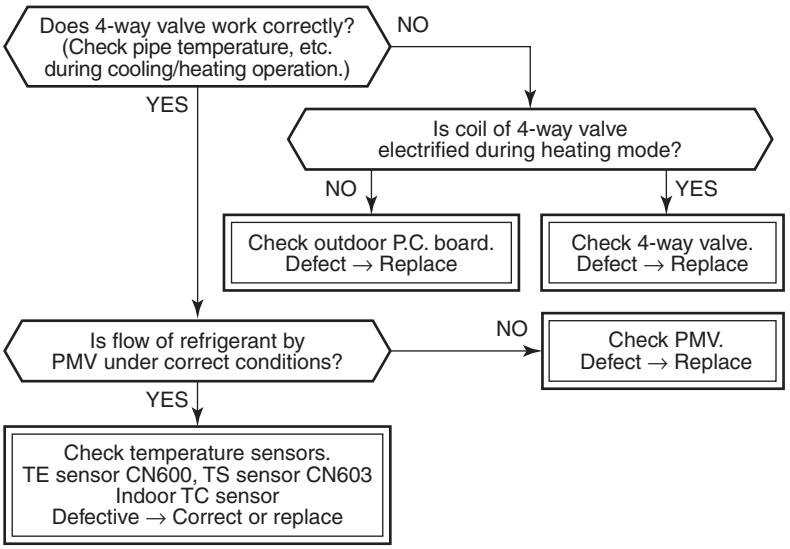
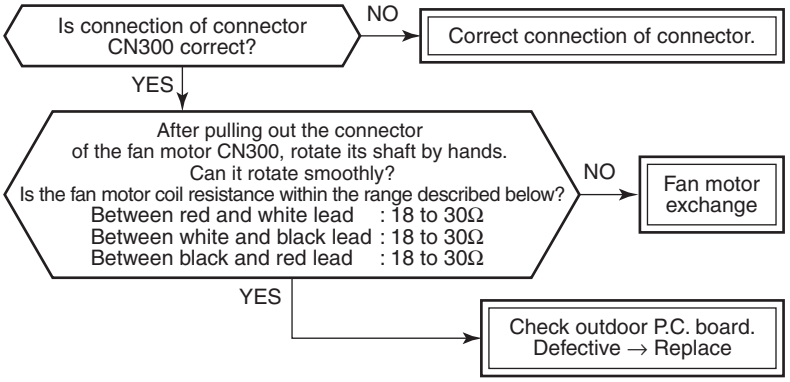
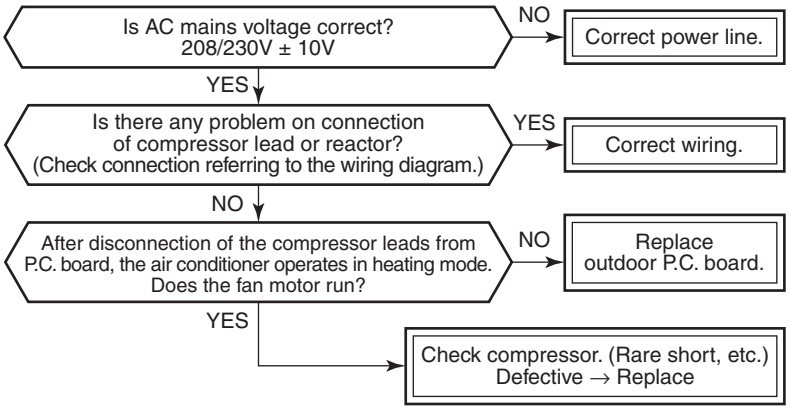
CODE No.	APPLICATION CONTROL KIT LED display	Check / Countermeasures (Part without special mention indicates a part of the outdoor unit.)
[H03]	D01 (Red) ◎ D02 (Yellow) ◎ D03 (Yellow) ● D04 (Yellow) ●	**[Power supply error, Current detection circuit error]** Are connections of wires correct? Between power cable and terminal block Between outdoor P.C. board and terminal block → NO → Correct wires YES → Check outdoor P.C. board. Defect → Replace
[L29]	D01 (Red) ○ D02 (Yellow) ● D03 (Yellow) ● D04 (Yellow) ○ or ● ◎ ◎ ●	**[Power supply error, Current detection circuit error]** Is AC mains voltage correct? 208/230V ± 10V → NO → Correct power supply line. YES → Is compressor under correct conditions? → NO → Compressor trouble Rare short check Defective → Replace YES → Check outdoor P.C. board. Defect → Replace
[P03]	D01 (Red) ● D02 (Yellow) ○ D03 (Yellow) ○ D04 (Yellow) ●	**[Discharge temp. error]** Is there gas leak? Is there refrigerant shortage? → YES → Repair defective position. Recharge refrigerant. NO → Is PMV under correct conditions? → NO → Repair defective position. Replace defective part. YES → Does an abnormal overload happen? → YES → Remove and improve the cause of overload. NO → Is connection of CN601 correct? Is resistance value of TD sensor correct? → NO → Correct connector. Sensor error → Replace YES → Check outdoor P.C. board. Defect → Replace
[P04]	D01 (Red) ○ D02 (Yellow) ● D03 (Yellow) ● D04 (Yellow) ○	**[Power supply error (Voltage error)]** Is AC mains voltage correct? 208/230V ± 10V → NO → Confirm power supply construction, etc. YES → Check outdoor P.C. board. Defect → Replace

LED display legend: ● Go off, ○ Go on, ◎ Flash (5Hz)

CODE No.	APPLICATION CONTROL KIT LED display	Check / Countermeasures (Part without special mention indicates a part of the outdoor unit.)
[P04]	D01 (Red) ○ D02 (Yellow) ● D03 (Yellow) ● D04 (Yellow) ○ or ● ○ ● ○	**[High-pressure SW error]** 1. High-pressure SW error 2. Service valve closed. 3. Indoor/Outdoor fan error 4. Clogging of indoor/outdoor PMV 5. Loading of indoor/outdoor heat exchangers or short-circuit 6. Overcharge of refrigerant
[P05]	D01 (Red) ◎ D02 (Yellow) ◎ D03 (Yellow) ● D04 (Yellow) ● or ○ ● ● ○	**[Power supply error (Voltage error)]** → Refer to columns [H03] and [P04] and then check power supply and voltage erro



LED display legend: ● Go off, ○ Go on, ◎ Flash (5Hz)

CODE No.	APPLICATION CONTROL KIT LED display	Check / Countermeasures (Part without special mention indicates a part of the outdoor unit.)
[P19]	—	**[4-way reversal error]**  ∗ In case of RAV-SP180AT2-UL, the coil of 4-way valve is electrified during cooling cycling. ∗ In cooling operation, [P19] error may be displayed when the refrigerant pressure rises high abnormally. In this case, remove the cause of pressure rising and then diagnose it again.
[P22]	D01 (Red) ○ D02 (Yellow) ○ D03 (Yellow) ○ D04 (Yellow) ●	**[Outdoor fan system error]** 
[P26]	D01 (Red) ◎ D02 (Yellow) ● D03 (Yellow) ● D04 (Yellow) ●	**[Short-circuit of compressor driving device]** 
[P29]	D01 (Red) ● D02 (Yellow) ◎ D03 (Yellow) ● D04 (Yellow) ●	**[Position detection circuit error]**

LED display legend: ● Go off, ○ Go on, ◎ Flash (5Hz)

RAV-SP240AT2-UL, RAV-SP300AT2-UL, SP360AT2-UL, SP420AT2-UL

1) This section describes the diagnostic method for each check code displayed on the remote controller.
2) In some cases, a check code indicates multiple symptoms.
   In this case, confirm LED display on the outdoor P.C. board to narrow the contents to be confirmed.
3) The check code on the remote controller is displayed only when the same error occurred continuously by multiple times while LED of the outdoor P.C. board displays even an error which occurred once.
   Therefore the display on the remote controller may differ from that of LED.

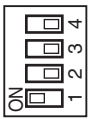
LED display on outdoor P.C. board

Dip switch setup

- When turning on 1) only of SW803, the latest error is displayed. As the memory is stored, it can be confirmed even if the power supply is turned off once. (excluding outside temp. sensor (TO) error)
- When the work finished or the outdoor temp. sensor (TO) error was found, turn off all of SW803. (The error which occurs at present is displayed.)

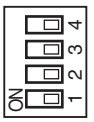
<Latest error display>

Only 1) of SW803 is ON.



<Error display, which occurs at present>

All SW803 are OFF. (Initial status)



Display selection

- When even a LED of D800 to D804 (Yellow) goes on, error occurrence is indicated. **<Display 1>**
- If pushing the button switch SW800 for 1 second under the above condition, the yellow LED is displayed with flashing. **<Display 2>**
- When pushing SW800 for 1 second again, the status returns to **<Display 1>**.
- The error contents can be confirmed by combining **<Display 1>** and **<Display 2>**.

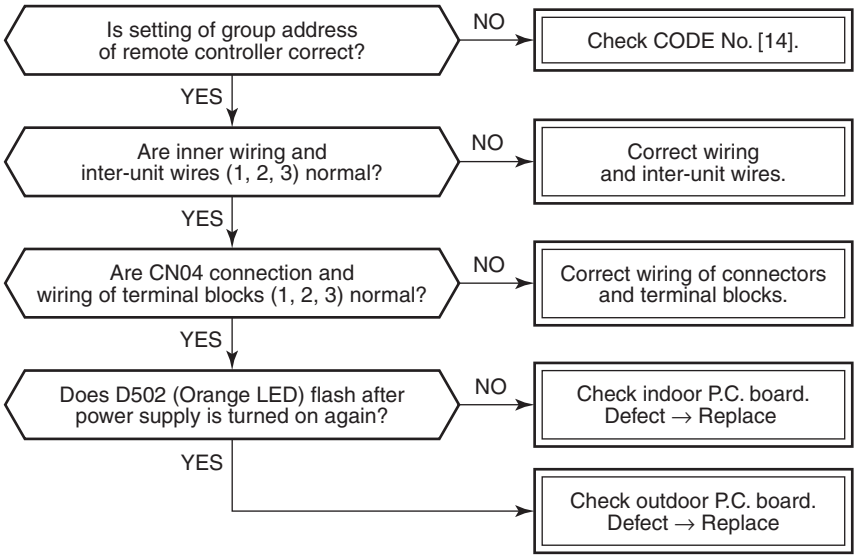
<Display 1> ⇔ <Display 2>

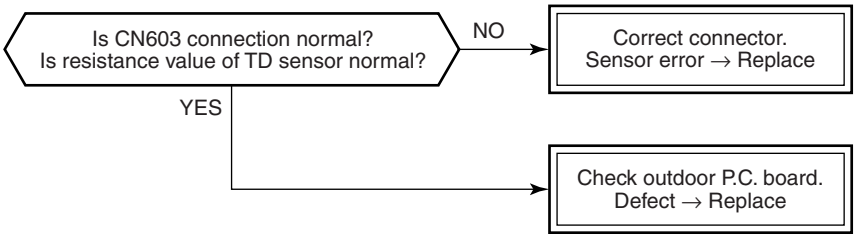
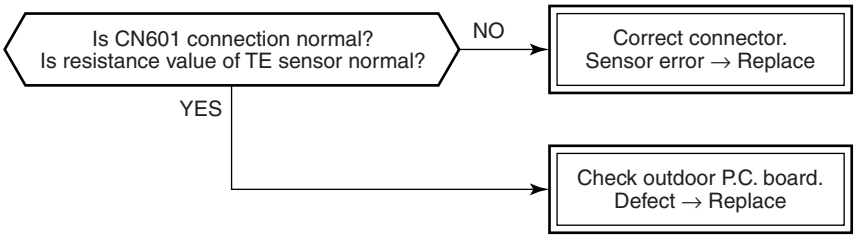
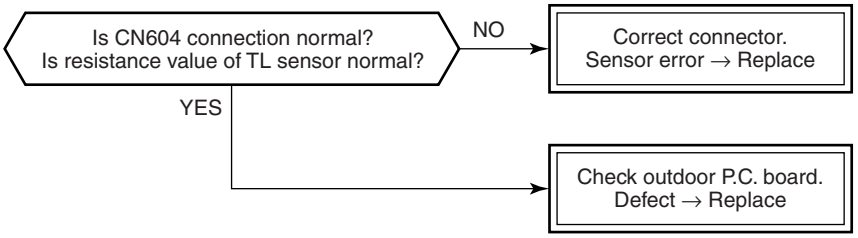
	(No error)	(Error occurred)	(Push SW800)
D800 (Yellow)	●	○	●
D801 (Yellow)	●	○	●
D802 (Yellow)	●	●	◎
D803 (Yellow)	●	●	●
D804 (Yellow)	●	○	●
D805 (Green)	○	○	○

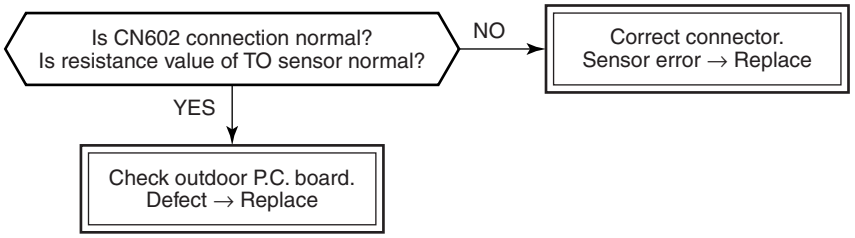
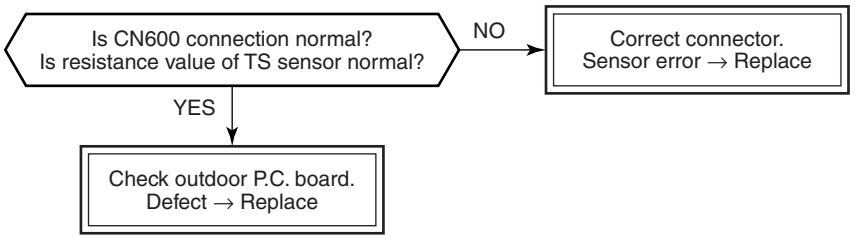
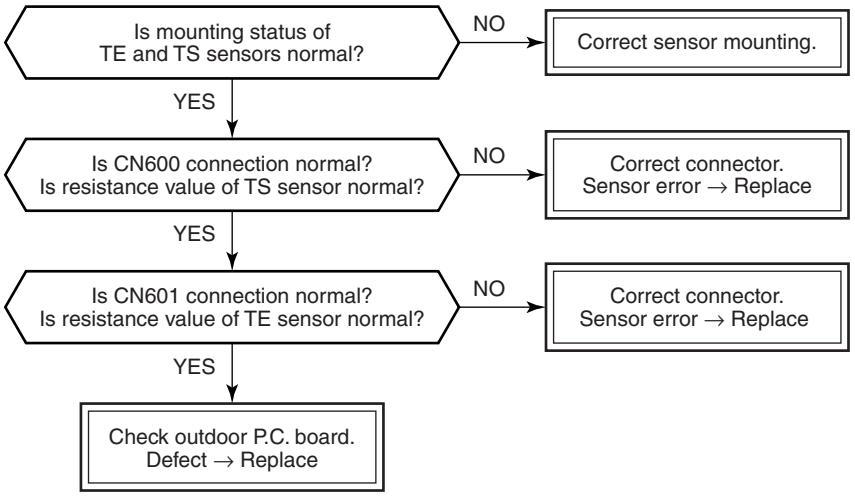
(Example of discharge temp. sensor error)

● : Go off, ○ : Go on, ◎ : Flash

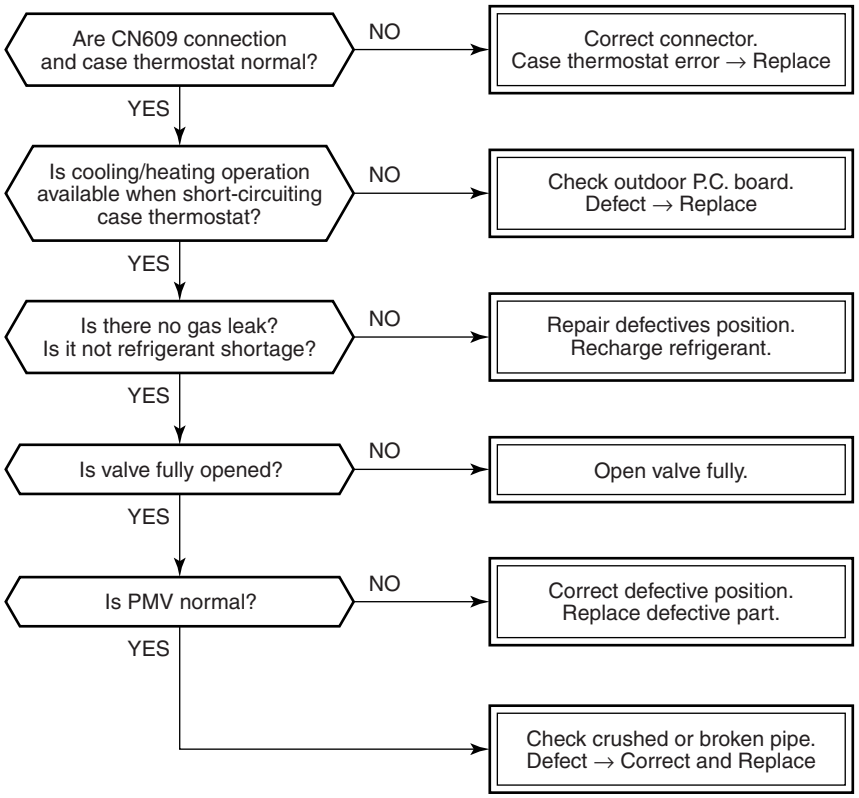
CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[E04]	—	**[Indoor/Outdoor communication error]**

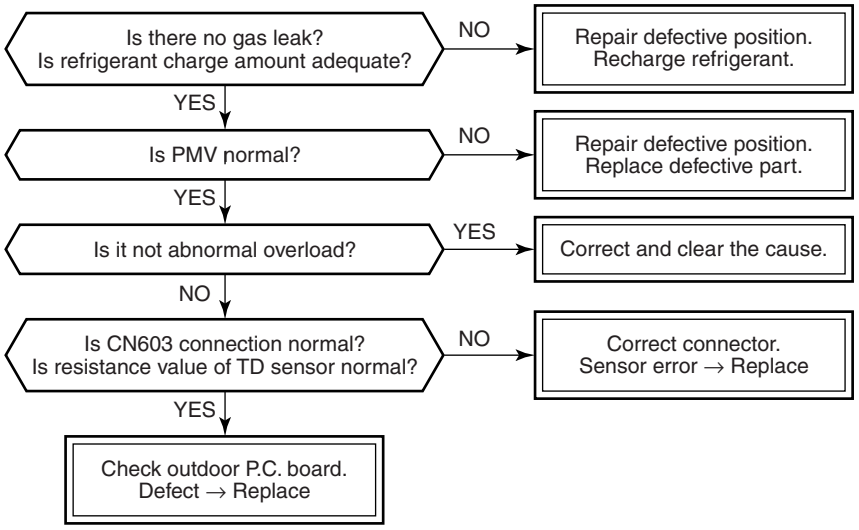

Is setting of group address of remote controller correct?
NO
Check CODE No. [14].
YES
Are inner wiring and inter-unit wires (1, 2, 3) normal?
NO
Correct wiring and inter-unit wires.
YES
Are CN04 connection and wiring of terminal blocks (1, 2, 3) normal?
NO
Correct wiring of connectors and terminal blocks.
YES
Does D502 (Orange LED) flash after power supply is turned on again?
NO
Check indoor P.C. board. Defect → Replace
YES
Check outdoor P.C. board. Defect → Replace

CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[F04]	<Display 1> <Display 2> ○ ● ○ ● ● ◎ ● ● ○ ● ○ ○	**[Discharge temp. sensor (TD) error]** 
[F06]		• There is a possibility that it is one of the following errors. Confirm LED on outdoor P.C. board to judge which error it is. Heat exchanger temp. sensor (TE) error, Heat exchanger temp. sensor (TL) error, Suction temp. sensor (TS) error, Miswiring of heat exchanger sensor (TE, TS)
	<Display 1> <Display 2> ○ ● ○ ◎ ● ◎ ● ● ○ ● ○ ○	**Heat exchanger temp. sensor (TE) error]** 
	<Display 1> <Display 2> ○ ◎ ○ ◎ ● ◎ ● ● ○ ● ○ ○	**[Heat exchanger temp. sensor (TL) error]** → Refer to **[F07]** column.
	<Display 1> <Display 2> ○ ● ○ ● ● ◎ ● ◎ ○ ● ○ ○	**[Suction temp. sensor (TS) error]** → Refer to **[F12]** column.
	<Display 1> <Display 2> ○ ◎ ○ ◎ ● ◎ ● ◎ ○ ● ○ ○	**[Miswiring of heat exchanger sensor (TE, TS)]** → Refer to **[F15]** column.
[F07]	<Display 1> <Display 2> ○ ◎ ○ ◎ ● ◎ ● ● ○ ● ○ ○	**[Heat exchanger temp. sensor (TL) error]** 

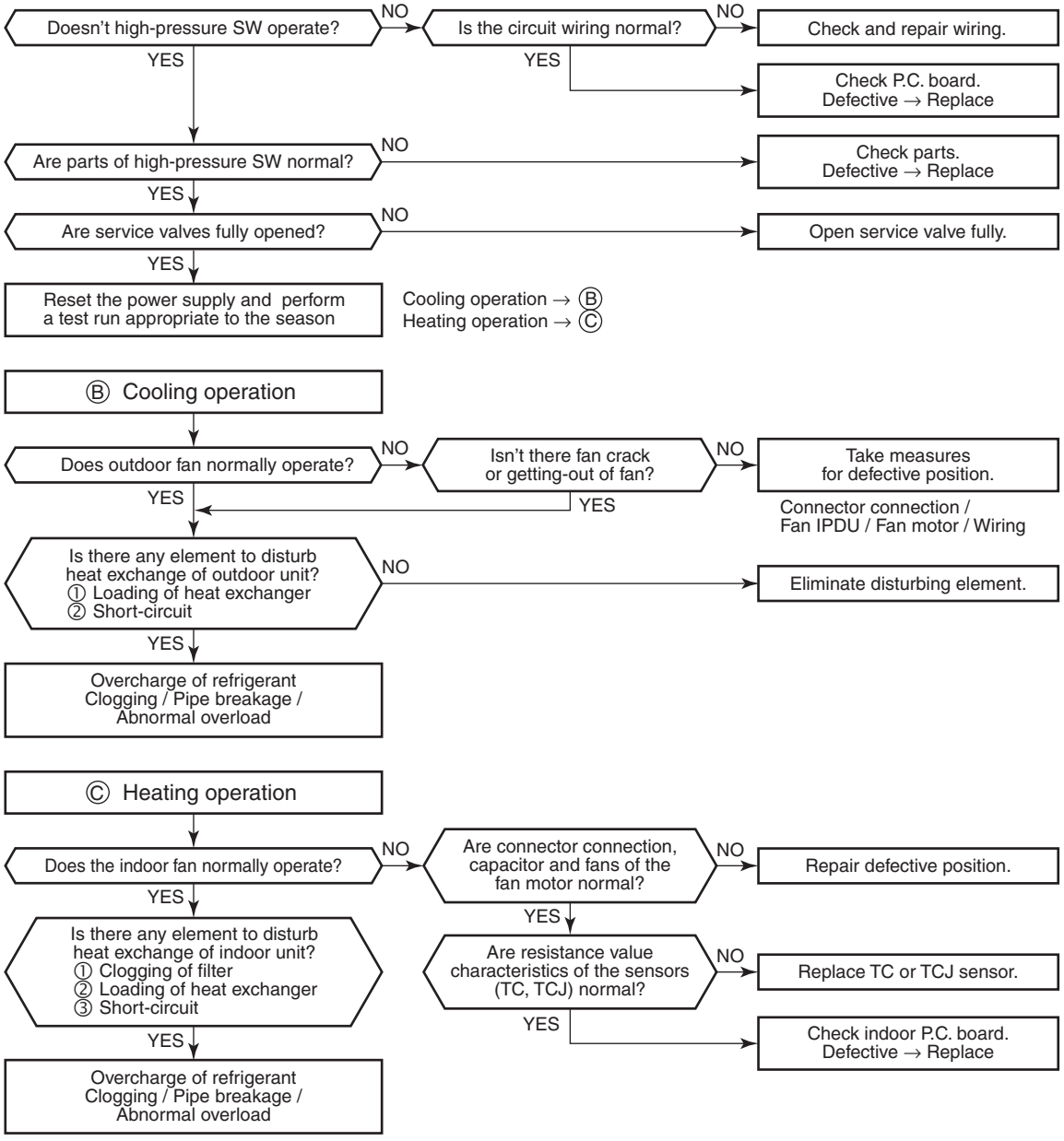
CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[F08]	<Display 1> <Display 2> ○ ● ○ ● ● ● ● ◎ ○ ● ○ ○	**[Outside air temp. sensor (TO) error]** 
[F12]	<Display 1> <Display 2> ○ ● ○ ● ● ◎ ● ◎ ○ ● ○ ○	**[Suction temp. sensor (TS) error]** 
[F13]	<Display 1> <Display 2> ○ ◎ ○ ● ● ◎ ● ◎ ○ ● ○ ○	**[Heat sink temp. sensor (TH) error]**
[F15]	<Display 1> <Display 2> ○ ◎ ○ ◎ ● ◎ ● ◎ ○ ● ○ ○	**[Miswiring of heat exchanger sensor (TE, TS)]** 
[F31]	<Display 1> <Display 2> ○ ◎ ○ ◎ ● ◎ ● ◎ ○ ◎ ○ ○	**[EEPROM error]**

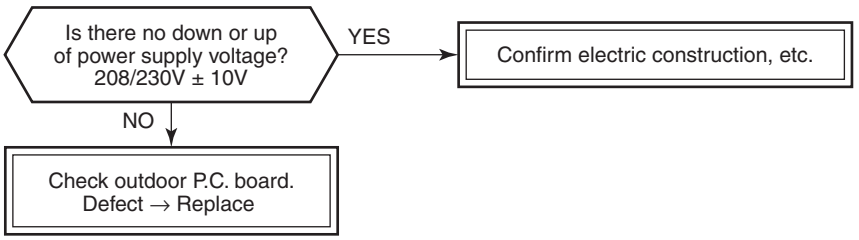
CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[H01]	<Display 1> <Display 2> ● ◎ ● ● ○ ● ● ● ○ ● ○ ○	**[Compressor break down]** Is power supply voltage normal? 208/230V ± 10V → NO → Correct power supply line. YES Is wire connection normal? Compressor lead (Board side, Compressor side), Reactor lead, Power supply lead → NO → Check wire connection and correct it. YES Is it not abnormal overload? → YES → Correct and clear the cause. NO Check outdoor P.C. board. Defect → Replace
[H02]	<Display 1> <Display 2> ● ● ● ◎ ○ ● ● ● ○ ● ○ ○	**[Compressor lock]** Is power supply voltage normal? 208/230V ± 10V → NO → Correct power supply line. YES Is wire connection normal? Compressor lead (Board side, Compressor side), Reactor lead, Power supply lead → NO → Check wire connection and correct it. YES Is compressor normal? → YES → Check outdoor P.C. board. Defect → Replace NO Is there no refrigerant stagnation? → NO → Compressor lock → Replace YES Does PMV normally operate? → NO → Check TE, TS sensors and PMV. Defect → Replace YES Check outdoor P.C. board. Defect → Replace
[H03]	<Display 1> <Display 2> ● ◎ ● ◎ ○ ● ● ● ○ ● ○ ○	**[Current detection circuit error]** Check outdoor P.C. board. Defect → Replace

<table>
<tr><th>CODE No.</th><th>Outdoor LED display</th><th>Check and troubleshooting
(Item without special mention Indicates part of outdoor unit.)</th></tr>
<tr><td>[H04]</td><td><Display 1> <Display 2>
● ●
● ●
○ ●
● ◎
○ ●
○ ○</td><td>[Case thermostat operation]
 
</td></tr>
<tr><td>[L10]</td><td><Display 1> <Display 2>
● ●
○ ◎
○ ●
● ◎
○ ●
○ ○</td><td>[Unset model type]: Only when service P.C. board is used
Cut jumper line according to the explanation sheet packaged with the service P.C. board.</td></tr>
<tr><td>[L29]</td><td colspan="2">∗ There is a possibility that it is one of the following errors.
Confirm LED on outdoor P.C. board to judge which error it is.
Communication error between MCU, Heat sing temp. sensor (TH) error, EEPROM error,
Unset model type, Heat sink overheat error, Gas leak detection, 4-way valve inverse error</td></tr>
<tr><td></td><td><Display 1> <Display 2>
● ◎
○ ●
○ ◎
● ◎
○ ◎
○ ○</td><td>[Communication error between MCU]
Check outdoor P.C. board. Defect → Replace</td></tr>
<tr><td></td><td><Display 1> <Display 2>
○ ◎
○ ◎
○ ◎
● ●
○ ●
○ ○</td><td>[Heat sink temp. sensor (TH) error] → Refer to [F13] column.</td></tr>
</table>

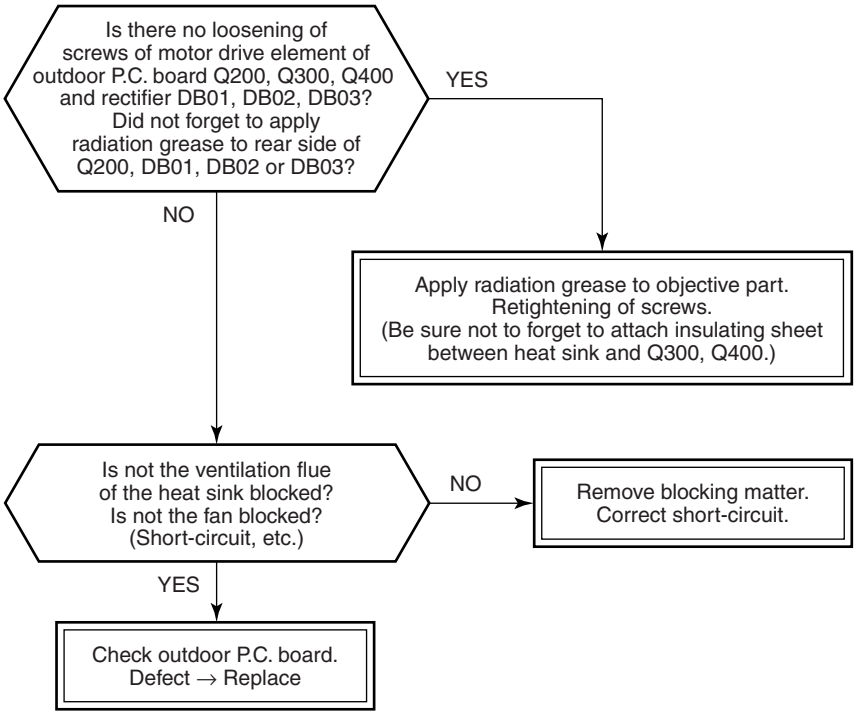
CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[L29] (Continued)	**<Display 1> <Display 2>** ○ ◎ ○ ◎ ● ◎ ● ◎ ○ ◎ ○ ○	**[EEPROM error]** → Refer to **[F31]** column.
	<Display 1> <Display 2> ● ● ○ ◎ ○ ● ● ◎ ○ ● ○ ○	**[Unset model type]** → Refer to **[L10]** column.
	<Display 1> <Display 2> ○ ◎ ○ ◎ ○ ◎ ● ● ○ ● ○ ○	**[Heat sink overheat error]** → Refer to **[P07]** column.
	<Display 1> <Display 2> ○ ◎ ○ ◎ ○ ◎ ● ◎ ○ ● ○ ○	**[Gas leak detection]** → Refer to **[P15]** column.
	<Display 1> <Display 2> ○ ◎ ○ ◎ ○ ● ● ● ○ ◎ ○ ○	**[4-way valve inverse error]** → Refer to **[P19]** column.
[P03]	**<Display 1> <Display 2>** ○ ◎ ○ ◎ ○ ● ● ● ○ ● ○ ○	**[Discharge temp. error]**  Is there no gas leak? Is refrigerant charge amount adequate? NO Repair defective position. Recharge refrigerant. YES Is PMV normal? NO Repair defective position. Replace defective part. YES Is it not abnormal overload? YES Correct and clear the cause. NO Is CN603 connection normal? Is resistance value of TD sensor normal? NO Correct connector. Sensor error → Replace YES Check outdoor P.C. board. Defect → Replace

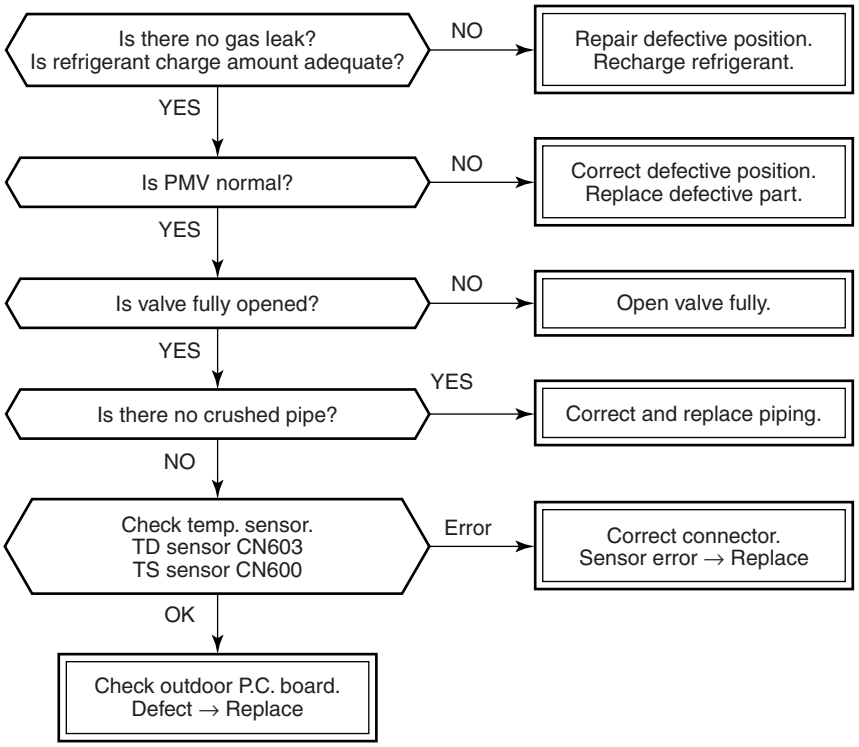
CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[P04]	* There is a possibility that it is one of the following errors. Confirm LED on outdoor P.C. board to judge which error it is. Power supply error (Vdc), High pressure protective operation, Case thermostat operation	
	<Display 1> <Display 2> ● ● ● ● ○ ◎ ● ● ○ ● ○ ○	**[Case thermostat operation]** → Refer to **[H04]** column.
	<Display 1> <Display 2> ○ ● ○ ● ○ ◎ ● ● ○ ● ○ ○	**[High-pressure SW error]** 1. High-pressure SW error 2. Service valve closed. 3. Indoor/Outdoor fan error 4. Clogging of indoor/outdoor PMV 5. Loading of indoor/outdoor heat exchangers or short-circuit 6. Overcharge of refrigerant



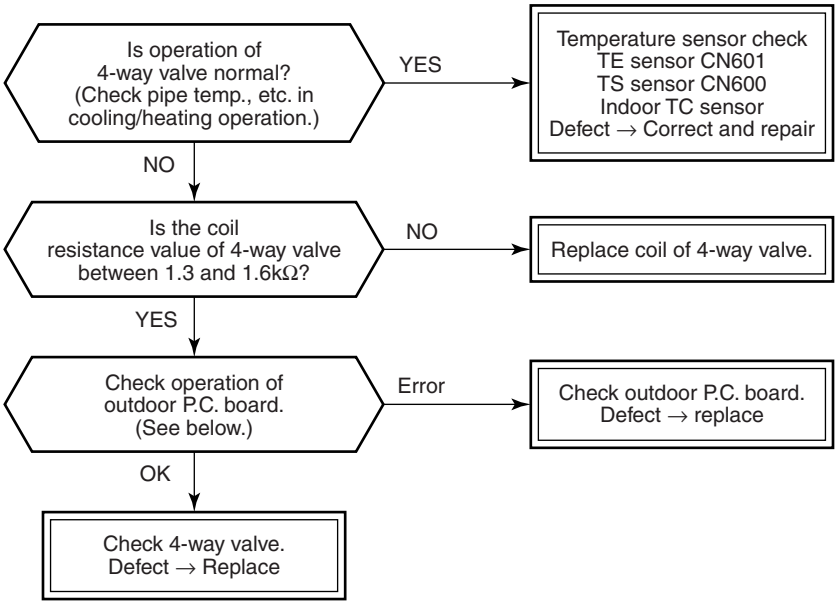
CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[P04] (Continued)	**<Display 1>** **<Display 2>** ○ ◎ ○ ● ○ ◎ ● ● ○ ● ○ ○	**[Power supply error (Vdc)]** → Refer to **[P05]** column.
	<Display 1> **<Display 2>** ○ ● ○ ● ○ ◎ ● ● ○ ◎ ○ ○	**[High pressure protective operation]** → Refer to **[P20]** column.
[P05]	**<Display 1>** **<Display 2>** ○ ◎ ○ ● ○ ◎ ● ● ○ ● ○ ○	**[Power supply error (Voltage error)]** 

CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[P07]	<Display 1> <Display 2>	[Heat sink overheat error]
[P15]	<Display 1> <Display 2>	[Gas leak detection]


Is there no loosening of screws of motor drive element of outdoor P.C. board Q200, Q300, Q400 and rectifier DB01, DB02, DB03? Did not forget to apply radiation grease to rear side of Q200, DB01, DB02 or DB03?
YES
NO
Apply radiation grease to objective part. Retightening of screws. (Be sure not to forget to attach insulating sheet between heat sink and Q300, Q400.)
Is not the ventilation flue of the heat sink blocked? Is not the fan blocked? (Short-circuit, etc.)
NO
Remove blocking matter. Correct short-circuit.
YES
Check outdoor P.C. board. Defect → Replace

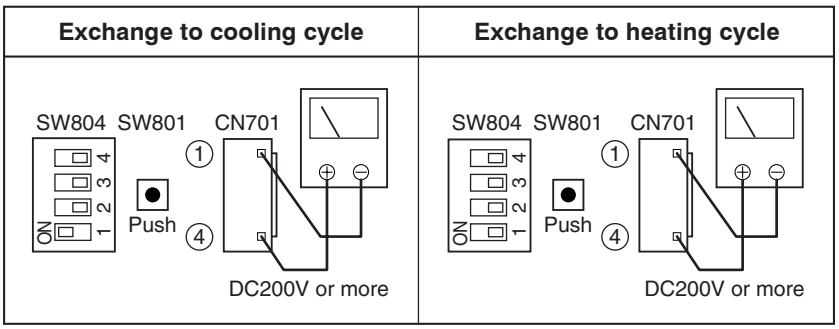


CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[P19]	<Display 1> <Display 2> ○ ◎ ○ ◎ ○ ● ● ● ○ ◎ ○ ○	**[4-way valve inverse error]**


Is operation of 4-way valve normal? (Check pipe temp., etc. in cooling/heating operation.)
YES
Temperature sensor check TE sensor CN601 TS sensor CN600 Indoor TC sensor Defect → Correct and repair
NO
Is the coil resistance value of 4-way valve between 1.3 and 1.6kΩ?
NO
Replace coil of 4-way valve.
YES
Check operation of outdoor P.C. board. (See below.)
Error
Check outdoor P.C. board. Defect → replace
OK
Check 4-way valve. Defect → Replace

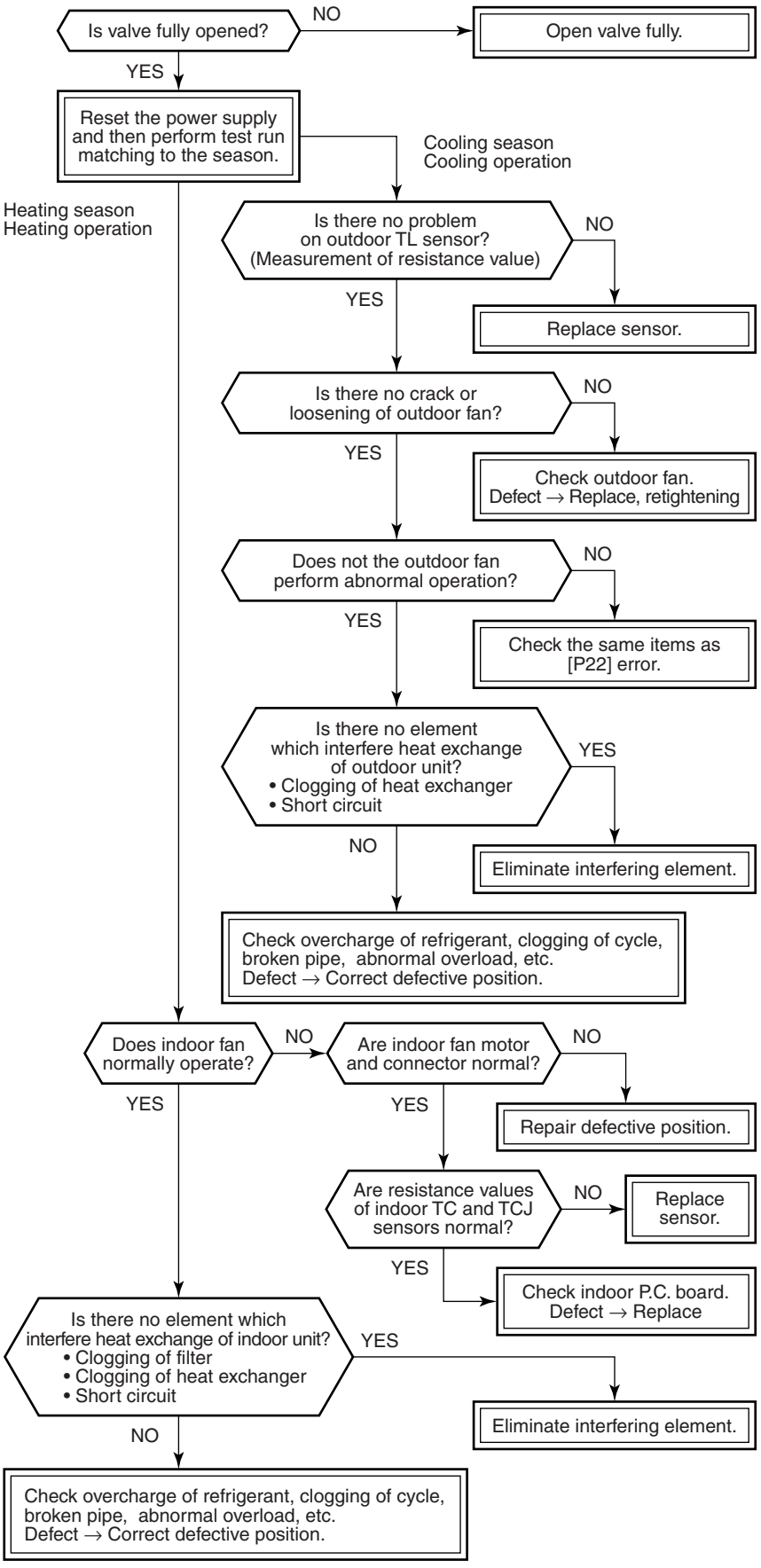
Check method of outdoor P.C. board operation (Self-hold valve type)

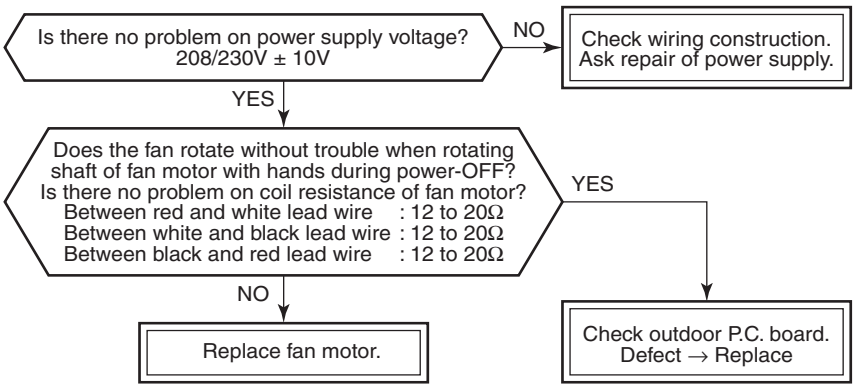
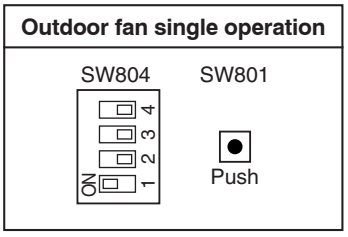
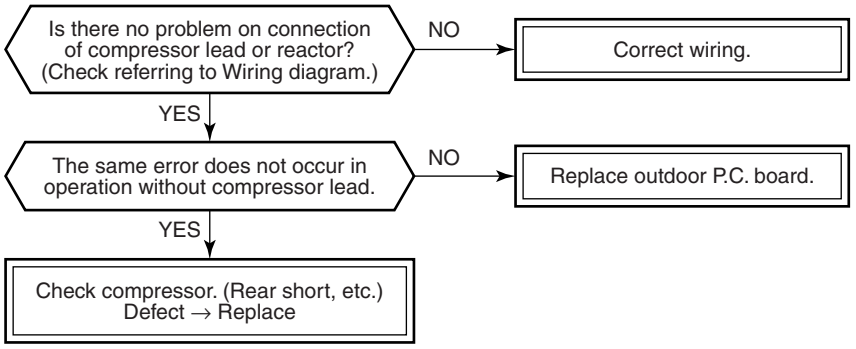
1) Set SW804 of Dip switch as the following figure and then push SW801 for approx. 1 second to check exchange operation to cooling cycle/heating cycle.
   - Power is turned on for approx. 10 seconds.
   - When checking again, check operation 1 minute or more after the first check because exothermic of part (Coil, resistance R700) is large. (There is no problem when coil is not connected.)
2) After check, turn off all the Dip switch SW804.



Note) Check by tester
Analog tester : Good if over DC200V
Digital tester : Good if Max. value is over DC200V though the varied value may be displayed.

CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[P20]	<Display 1> <Display 2>	[High pressure protective operation]


Is valve fully opened?
NO
Open valve fully.
YES
Reset the power supply and then perform test run matching to the season.
Cooling season
Cooling operation
Heating season
Heating operation
Is there no problem on outdoor TL sensor? (Measurement of resistance value)
NO
YES
Replace sensor.
Is there no crack or loosening of outdoor fan?
NO
YES
Check outdoor fan.
Defect → Replace, retightening
Does not the outdoor fan perform abnormal operation?
NO
YES
Check the same items as [P22] error.
Is there no element which interfere heat exchange of outdoor unit?
• Clogging of heat exchanger
• Short circuit
YES
NO
Eliminate interfering element.
Check overcharge of refrigerant, clogging of cycle, broken pipe, abnormal overload, etc.
Defect → Correct defective position.
Does indoor fan normally operate?
NO
Are indoor fan motor and connector normal?
NO
YES
YES
Repair defective position.
Are resistance values of indoor TC and TCJ sensors normal?
NO
Replace sensor.
YES
Check indoor P.C. board.
Defect → Replace
Is there no element which interfere heat exchange of indoor unit?
• Clogging of filter
• Clogging of heat exchanger
• Short circuit
YES
Eliminate interfering element.
NO
Check overcharge of refrigerant, clogging of cycle, broken pipe, abnormal overload, etc.
Defect → Correct defective position.

CODE No.	Outdoor LED display	Check and troubleshooting (Item without special mention Indicates part of outdoor unit.)
[P22]	<Display 1> <Display 2>	**[Fan system error]**  Is there no problem on power supply voltage? 208/230V ± 10V NO Check wiring construction. Ask repair of power supply. YES Does the fan rotate without trouble when rotating shaft of fan motor with hands during power-OFF? Is there no problem on coil resistance of fan motor? Between red and white lead wire : 12 to 20Ω Between white and black lead wire : 12 to 20Ω Between black and red lead wire : 12 to 20Ω YES NO Replace fan motor. Check outdoor P.C. board. Defect → Replace **Single operation check for outdoor fan** 1) Set SW804 of Dip switch as the following figure and then push SW801 for approx. 1 second to check single operation of outdoor fan. Use this method to check which fan, upper or lower fan, has a trouble. • When pushing SW801 for 1 second again or 2 minutes passed, the fan stops. 2) After check, turn off all Dip switch SW804. 
[P26]	<Display 1> <Display 2>	**[Short-circuit of compressor drive element]**  Is there no problem on connection of compressor lead or reactor? (Check referring to Wiring diagram.) NO Correct wiring. YES The same error does not occur in operation without compressor lead. NO Replace outdoor P.C. board. YES Check compressor. (Rear short, etc.) Defect → Replace
[P29]	<Display 1> <Display 2>	**[Position detection circuit error]**
— No code	<Display 1> <Display 2>	**[Other error]** Compressor disorder due to sudden change of load, etc. ∗ Although the display of outdoor LED outputs, the unit automatically restarts and error is not determined. ∗ LED display also may output due to negative phase of compressor or wire coming-off.

Temperature sensor Temperature – Resistance value characteristic table

TA, TC, TCJ, TE, TS, TO sensors

Representative value

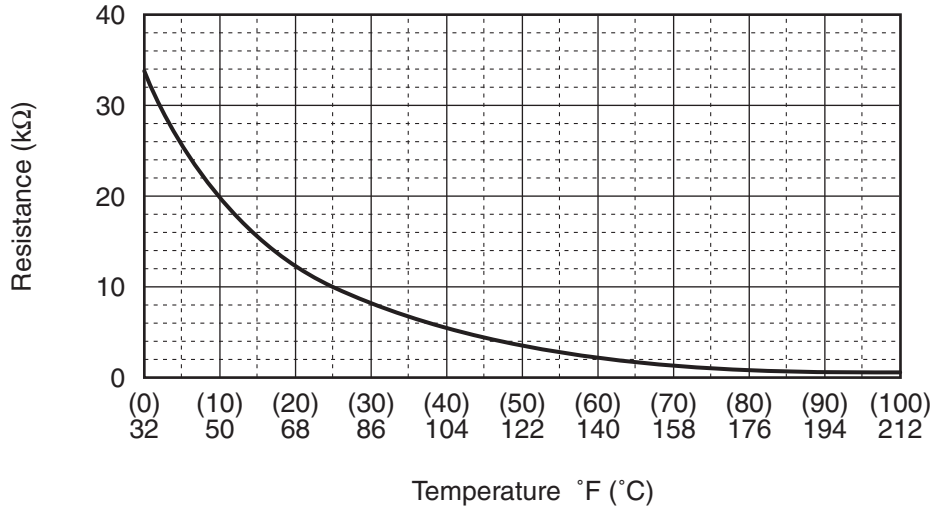
Temperature °F (°C)	Resistance value (kΩ)		
	(Minimum value)	(Standard value)	(Maximum value)
32 (0)	32.33	33.80	35.30
50 (10)	19.63	20.35	21.09
68 (20)	12.23	12.59	12.95
77 (25)	9.75	10.00	10.25
86 (30)	7.764	7.990	8.218
104 (40)	5.013	5.192	5.375
122 (50)	3.312	3.451	3.594
140 (60)	2.236	2.343	2.454
158 (70)	1.540	1.623	1.709
176 (80)	1.082	1.146	1.213
194 (90)	0.7740	0.8237	0.8761
212 (100)	0.5634	0.6023	0.6434

TD, TL sensors

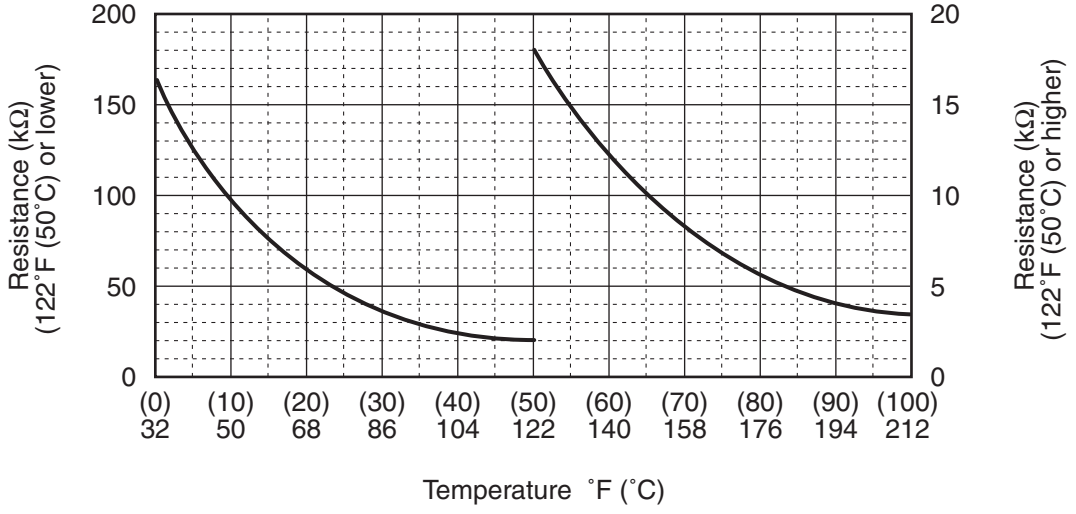
Representative value

Temperature °F (°C	Resistance value (kΩ)		
	(Minimum value)	(Standard value)	(Maximum value)
32 (0)	150.5	161.3	172.7
50 (10)	92.76	99.05	105.6
68 (20)	58.61	62.36	66.26
77 (25)	47.01	49.93	52.97
86 (30)	37.93	40.22	42.59
104 (40)	25.12	26.55	28.03
122 (50)	17.00	17.92	18.86
140 (60)	11.74	12.34	12.95
158 (70)	8.269	8.668	9.074
176 (80)	5.925	6.195	6.470
194 (90)	4.321	4.507	4.696
212 (100)	3.205	3.336	3.468

TA, TC, TCJ, TE, TS, TO sensors



TD, TL sensors



* As TH sensor (Outdoor unit heat sink temp. sensor) is incorporated in the outdoor control P.C. board, the resistance value cannot be measured.

9. REPLACEMENT OF SERVICE P.C. BOARD

9-1. Outdoor Unit

1. Setting the jumper wires and DIP switches

Part name		Function	Setting
Jumper wire	J800 to J803	Model switching	Cut these jumper wires according to the following table.
	J804 to J810	Settings	Set these jumper wires to the settings of the P.C. board before replacement.
DIP switch	SW802	Settings	Set SW802 to the setting of the P.C. board before replacement.
	SW803	LED indication switching	Set SW803 to all OFF.
	SW804	Special operations for service	Set SW804 to all OFF.

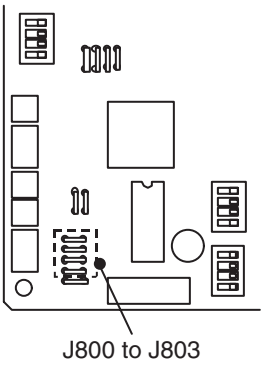
Model switching (J800 to J803)

Since this service P.C. board is available for several models, cut the jumper wires according to the following table.

If they are not cut correctly, an error code “L10” or “L29” appears on the remote controller and the operation of the air conditioner is disabled.

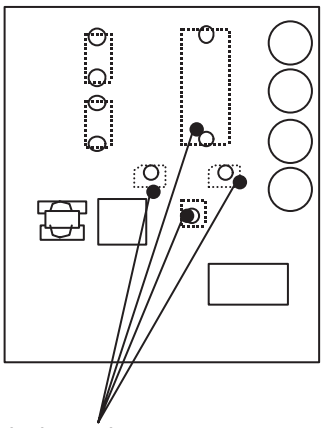
Model name	J 800	J 801	J 802	J 803
Factory setting (default)	○	○	○	○
RAV-SP300AT2-UL	○	×	○	×
RAV-SP360AT2-UL	×	×	○	×
RAV-SP420AT2-UL	○	○	×	×

○ : Connected, × : Cut

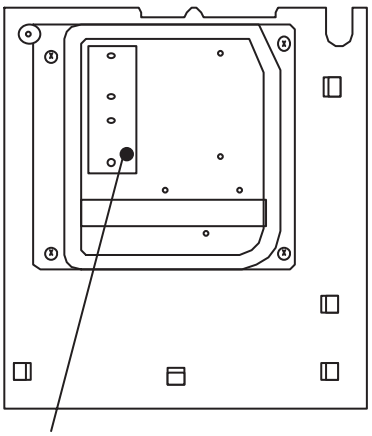


2. Installing the P.C. board

1) Apply thermal grease to the back (heat sink contacting side) of devices Q200, Q650, DB01, and DB02. (Q300 and Q400 are not necessary to be applied thermal grease.)
2) Reuse the insulating sheet. When a small amount of thermal grease is applied to the back of the insulating sheet, it adheres temporarily to the heat sink, which makes it easy to attach the insulating sheet.
3) Insert the P.C. board, align the holes of the insulating sheets, semiconductor devices, and heat sinks, and then secure them with screws.
4) Connect the lead wires according to the wiring diagram sticked on the backside of the pannel .



Apply thermal grease to the back (heat sink contacting side) of Q200, Q650, DB01, and DB02.



Reuse the insulating sheet. Applying thermal grease to the back of the insulating sheet makes it easy to attach the insulating sheet.

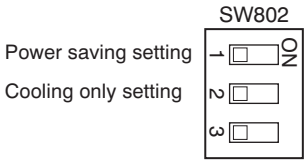
10. SETUP AT LOCAL SITE AND OTHERS

10-1. Outdoor Unit

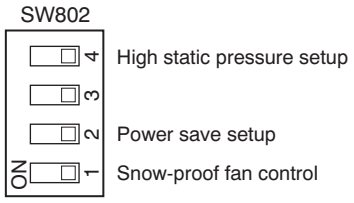
10-1-1. Various Setting on Outdoor Unit (Power save, Cooling-only, etc.)

The following settings are available by DIP switch setup and jumper line setup.

<RAV-SP180AT2-UL>

Function	Set position	Control contents
Power save setup		When using the power saving function, turn on switches. The control to lower the compressor frequency (approx. -10%) is performed by indoor heat exchanger temp. in heating operation.
Cooling-only setup		When using the outdoor unit as a cooling-only machine, turn on switches. (“OF” of DN cord on the remote controller also can be used for changing the machine to the cooling-only model.)

<RAV-SP240, SP300, SP360, SP420AT2-UL>

Function	Set position	Control contents
High static pressure setup	 ∗ all are OFF at shipment.	Turn the switch to ON when mounting a duct to the discharge port of the outdoor unit. Add 3 taps to the upper limit value of the outdoor fan tap. The operation is performed with (Max: Upper fan: 890 rpm / Lower fan: 910 rpm (WF)). In this case, the upper limit value of static pressure for duct is 5Pa or less on 77°F (25°C) degrees and please use straight duct. In this case, the outdoor noise level may increase.
Power save setup		Turn the switch to ON when using the power save function. The control to lower the compressor frequency (Approx. –10%) is performed by indoor heat exchanger temp. in heating operation.
Snow-proof fan control		When snow enters from clearance of the fan guard or heat exchanger into blast path and it is accumulated, the control to prevent generation of motor lock is validated. When outside temp. is below 32°F (0°C) though the compressor stops, the outdoor fan operates with W5.
Defrost time change	J805, J806	The defrost interval is cut to shorten it than the standard status. For contents of control and cutting method, refer to **10. Defrost control** (See to Page 43).
Max. frequency change	J807	When it is needed to lower the maximum value of the compressor frequency, cut the jumper line. Max. frequency at cooling/heating is lowered. In this case the Max. capacity decreases. **Max. frequency of compressor**
Cooling-only setup	J808	When using the air conditioner as a cooling-only conditioner, cut the jumper line. (An air conditioner can be changed to cooling-only conditioner by “0F” of DN code on the remote controller.)

Max. frequency of compressor

RAV-Model	SP240		SP300		SP360, SP420	
	COOL	HEAT	COOL	HEAT	COOL	HEAT
Standard status	72.0	99.6	53.4	71.4	64.2	90.6
When J807 is cut	72.0	79.2	53.4	64.2	64.2	72.0

10-1-2. Service Support Function (LED Display, Switch Operation)

1. Outline

A various setup and operation check can be performed by DIP switches at 3 positions (SW802, SW803, SW804) and the pushdown button switches (SW800, SW801) at 2 positions.

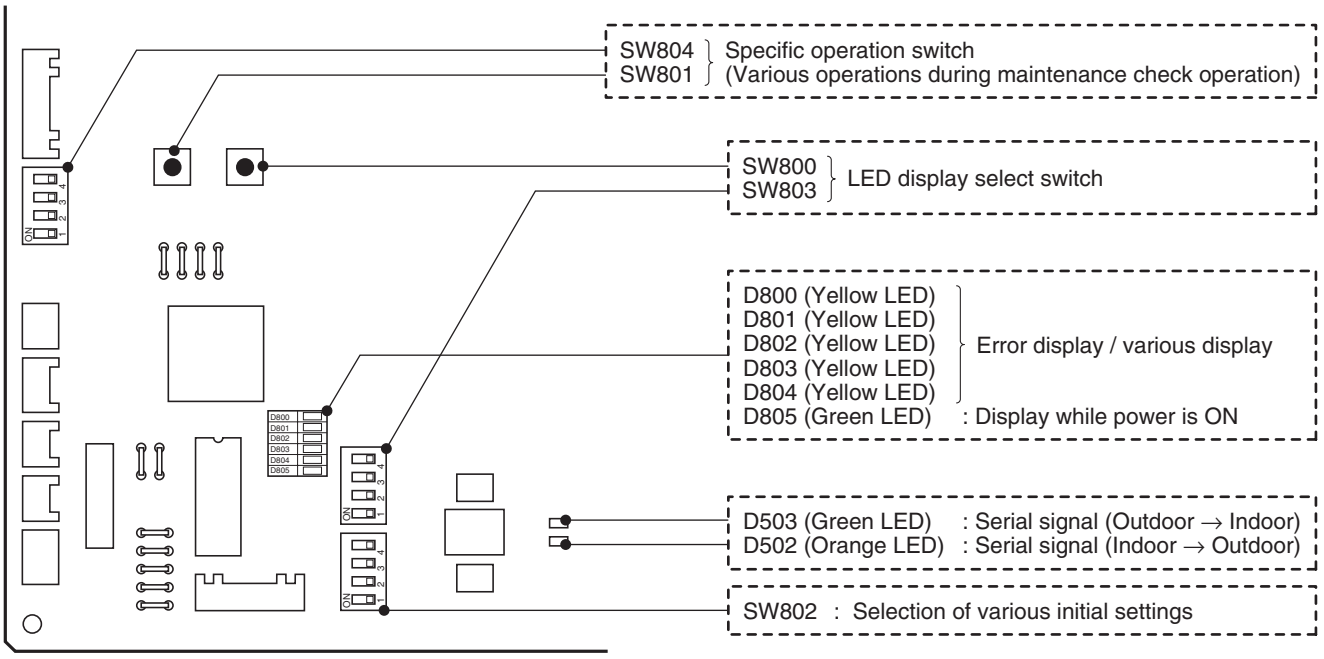
Operation part

Part No.	Specifications	Operation contents
SW800	Pushdown button switch	Exchanges the displayed contents of LED (D800 to D804) on the outdoor control P.C. board.
SW803	DIP switch	
SW801	Pushdown button switch	Performs the specific operation to check maintenance.
SW804	DIP switch	
SW802	DIP switch	Performs various initial settings. (Refer to 10-1-2.)

Display part

Part No.	Specifications	Operation contents
D502	Orange LED	Indoor/Outdoor communication (Serial communication) signal display (Receive signal from indoor signal)
D503	Green LED	Indoor/Outdoor communication (Serial communication) signal display (Send signal from outdoor signal)
D800 to D804	Yellow LED	Error display When all SW803 are OFF, or when any of D800 to D804 goes on, LED displays that the outdoor controller detects an error. When status of SW803 is other than OFF, various indications are displayed.
D805	Green LED	Power-ON display When the power of the outdoor unit is turned on, LED goes on. When SW801 and SW804 operate the specific operation, LED flashes.

∗ All LED are colorless when it goes off.


SW804
SW801
Specific operation switch
(Various operations during maintenance check operation)
SW800
SW803
LED display select switch
D800 (Yellow LED)
D801 (Yellow LED)
D802 (Yellow LED)
D803 (Yellow LED)
D804 (Yellow LED)
Error display / various display
D805 (Green LED) : Display while power is ON
D503 (Green LED) : Serial signal (Outdoor → Indoor)
D502 (Orange LED) : Serial signal (Indoor → Outdoor)
SW802 : Selection of various initial settings

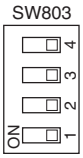
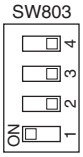
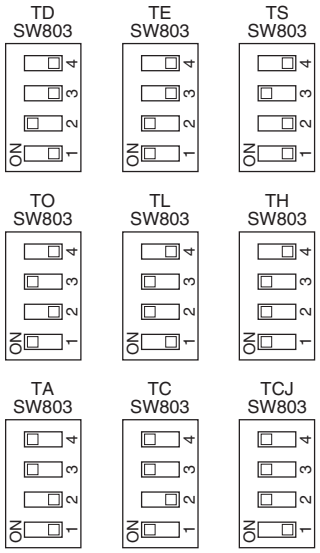
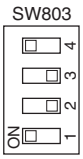
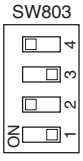
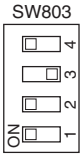
10-1-3. Others

<RAV-SP240, SP300, SP360, SP420AT2-UL>

1. Selection of LED display (SW800, SW803 operation)

1) Display selection list

The displayed contents of LED D800 to D804 on the outdoor control P.C. board can be exchanged by operation of SW803.

Switch	Function / Contents	Refer
	Error display (Error generating at present) Error generating at present is displayed. This switch goes off when an error does not generate.	Refer to Page 77.
	Error display (The latest error: Latest error including present) After error status was cleared, the error which generated before can be confirmed by this setting. (Reconfirmation is available even if power supply was turned off once.) • If an error generates at present, the same contents as those of error which is generating at present are displayed. • Only error of TO sensor is not displayed by this setting. (Confirm it by setting of error which is generating at present.)	Refer to Page 77.
	Temperature sensor display The detected value of temperature sensor is displayed.	Refer to Page 78.
	Current display The current value which flows in the outdoor unit is displayed.	Refer to Page 78.
	Compressor operation frequency display The operation frequency of the compressor is displayed.	Refer to Page 78.
	PMV opening display The opening of PMV (Pulse Motor Valve) is displayed.	Refer to Page 78.

2) Error display

The error which is generating at present and the latest error (Latest error information including present) can be confirmed by lighting LED D800 toD804 on the outdoor control P.C. board.

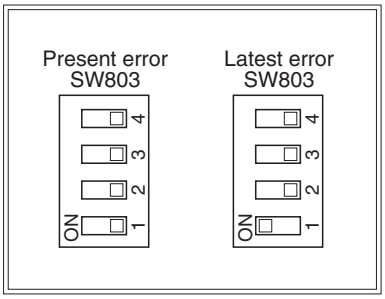
a) When all DIP switch SW803 are OFF, the status of error which is generating at present is displayed.

b) <1> only of DIP switch SW803 is turned on, the error which generated before (Latest error information including present) is displayed.a)

c) If there is an error, any of LED D800 to D804 goes on. (Display 1)

d) When pushing the pushdown button switch SW800 for approx. 1 second, the display is exchanged. (Display 2)

e) When pushing SW800 again or after 2 minutes, the status returns to that of Display 1.



(Legend)

● D800 (Yellow)
● D801 (Yellow)
◎ D802 (Yellow)
● D803 (Yellow)
● D804 (Yellow)
○ D805 (Green)

● : Go off, ○ : Go on, ◎ : Flash

Display 1) (Initial display)	Display 2) (SW800 operation)	Error contents	Wired remote controller Error code
●●●●●○	●●●●●○	Normal	—
○○●●○○	●●◎●●○	Discharge temp. sensor (TD) error	F04
	●◎◎●●○	Heat exchanger temp. sensor (TE) error	F06
	◎◎◎●●○	Heat exchanger temp. sensor (TL) error	F06, F07
	●●●◎●○	Outside temp. sensor (TO) error	F08
	●●◎◎●○	Suction temp. sensor (TS) error	F06, F12
	◎●◎◎●○	Heat sink temp. sensor (TH) error	F13, L29
	◎◎◎◎●○	Heat exchanger sensor (TE, TS) miswiring	F06, F15
	◎◎◎◎◎○	EEPROM error	F31, L29
●●○●○○	◎●●●●○	Compressor break down	H01
	●◎●●●○	Compressor lock	H02
	◎◎●●●○	Current detection circuit error	H03
	●●◎●●○	Case thermostat operation	H04
●○○●○○	●◎●◎●○	Model unset	L10, L29
	◎●◎◎◎○	Communication error between MCU	L29
	◎◎◎◎◎○	Other error (Compressor disorder, etc.)	Error is not determined.
○○○●○○	◎◎●●●○	Discharge temp. error	P03
	●●◎●●○	High-pressure SW error	P04
	◎●◎●●○	Power supply error	P05
	◎◎◎●●○	Heat sink overheat error	P07, L29
	◎◎◎◎●○	Gas leak detection	P15, L29
	◎◎●●◎○	4-way valve reverse error	P19, L29
	●●◎●◎○	High pressure protective operation	P04, P20
	●◎◎●◎○	Fan system error	P22
	●◎●◎◎○	Driving element short-circuit	P26
	◎●◎◎◎○	Position detection circuit erro	P29

* As the error code displayed on the wired remote controller may differ according to type of indoor model, multiple codes are described.

3) Sensor, current, compressor operation frequency, PMV opening display

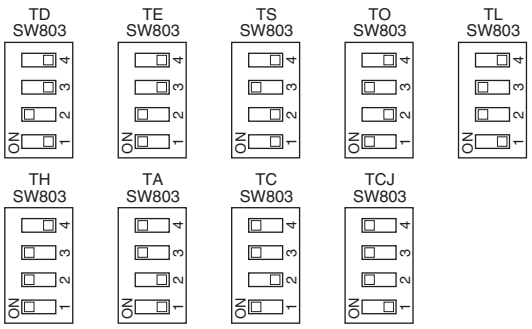
The values detected by the controller, such as temperature sensor or current value are simply confirmed.

(Legend)

- ● D800 (Yellow)
- ● D801 (Yellow)
- ● D802 (Yellow)
- ● D803 (Yellow)
- ● D804 (Yellow)
- ○ D805 (Green)

● : Go off, ○ : Go on

Item setup / LED display	Temperature sensor °F (°C)	Current (A)	Compressor operation frequency (rpm)	PMV opening (Pulse)
●●●●●○	Below –13 (–25)	0 to 0.9	0 to 4	0 to 19
○●●●●○	–13 (–25) to –5.8 (–21)	1 to 1.9	5 to 9	20 to 39
●○●●●○	–4 (–20) to 3.2 (–16)	2 to 2.9	10 to 14	40 to 59
○○●●●○	5 (–15) to 12.2 (–11)	3 to 3.9	15 to 19	60 to 79
●●○●●○	14 (–10) to 23 (– 5)	4 to 4.9	20 to 24	80 to 99
○●○●●○	23 (–5) to 30.2 (–1)	5 to 5.9	25 to 29	100 to 119
●○○●●○	32 (0) to 39.2 (4)	6 to 6.9	30 to 34	120 to 139
○○○●●○	41 (5) to 48.2 (9)	7 to 7.9	35 to 39	140 to 159
●●●○●○	50 (10) to 57.2 (14)	8 to 8.9	40 to 44	160 to 179
○●●○●○	59 (15) to 66.2 (19)	9 to 9.9	45 to 49	180 to 199
●○●○●○	68 (20) to 75.2 (24)	10 to 10.9	50 to 54	200 to 219
○○●○●○	77 (25) to 84.2 (29)	11 to 11.9	55 to 59	220 to 239
●●○○●○	86 (30) to 93.2 (34)	12 to 12.9	60 to 64	240 to 259
○●○○●○	95 (35) to 102.2 (39)	13 to 13.9	65 to 69	260 to 279
●○○○●○	104 (40) to 111.2 (44)	14 to 14.9	70 to 74	280 to 299
○○○○●○	113 (45) to 120.2 (49)	15 to 15.9	75 to 79	300 to 319
●●●●○○	122 (50) to 129.2 (54)	16 to 16.9	80 to 84	320 to 339
○●●●○○	131 (55) to 138.2 (59)	17 to 17.9	85 to 89	340 to 359
●○●●○○	140 (60) to 147.2 (64)	18 to 18.9	80 to 84	360 to 379
○○●●○○	149 (65) to 156.2 (69)	19 to 19.9	95 to 99	380 to 399
●●○●○○	158 (70) to 165.2 (74)	20 to 20.9	100 to 104	400 to 419
○●○●○○	167 (75) to 174.2 (79)	21 to 21.9	105 to 109	420 to 439
●○○●○○	176 (80) to 183.2 (84)	22 to 22.9	110 to 114	440 to 459
○○○●○○	185 (85) to 192.2 (89)	23 to 23.9	115 to 119	460 to 479
●●●○○○	194 (90) to 201.2 (94)	24 to 24.9	120 to 124	480 to 499
○●●○○○	203 (95) to 210.2 (99)	25 to 25.9	125 to 129	500
●○●○○○	212 (100) to 219.2 (104)	26 to 26.9	130 to 134	—
○○●○○○	221 (105) to 228.2 (109)	27 to 27.9	135 to 139	—
●●○○○○	230 (110) to 237.2 (114)	28 to 28.9	140 to 144	—
○●○○○○	239 (115) to 246.2 (119)	29 to 29.9	145 to 149	—
●○○○○○	Over 248 (120)	30 to 30.9	150 to 154	—
○○○○○○	Sensor error, unconnected	Over 31	Over 155	—



∗ As TD, TL and TH are sensors for high temperature, there is error at normal temperature or below position.

∗ For current value, the current for the outdoor unit only is displayed.

4) Specific operation for maintenance check (SW801, SW804)

The following specific operations for the maintenance check are performed by operation of SW801 or SW804.

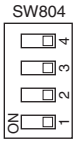
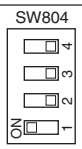
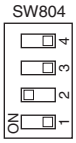
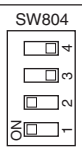
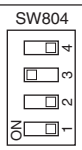
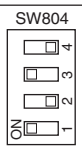
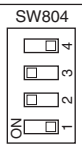
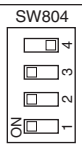
a) Select DIP switch SW804. (See table below)

b) Push the pushdown button switch SW801 for approx. 1 second.

c) The following functions start. While each function starts, LED D805 (Green) flashes.

d) When pushing the pushdown button switch SW801 again for approx. 1 second, when selecting DIP switch SW804 or when the specified time of each function elapsed, each function stops and LED D805 (Green) returns to the continuous lighting.

<Specific operation>

SW804	Operation when pushdown button switch SW801 is pushed
	Refrigerant recovery operation The outdoor unit performs cooling operation. The indoor unit does not work by this operation alone. Therefore operate the fan beforehand.
	Indoor cooling test run demand The cooling test run is performed. (→ **Note 1**)
	Indoor heating test run demand The heating test run is performed. (→ **Note 1**)
	Fan motor forced operation Drive the fan motor forcedly. When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control.
	(No operation especially)
	PMV full open operation Open PMV (Pulse Motor Valve) fully. When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control.
	PMV full close operation Close PMV (Pulse Motor Valve) fully. When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control.
	PMV middle opening operation Set PMV (Pulse Motor Valve) to middle opening (250 pulses). When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control.

[NOTE]
Although these operations can be performed even during operation, basically perform operation while the unit stops.
If performing this operation during driving the unit, it is dangerous because the pressure may change suddenly.

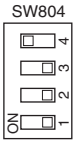
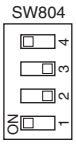
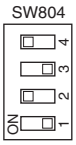
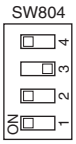
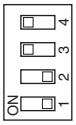
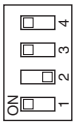
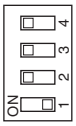
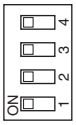
Note 1) Indoor cooling test run demand / Indoor heating test run demand

Only when combining with the following indoor unit, cooling/heating operation can be performed from the outdoor unit. Test run is available: Indoor unit (4-Way, Under ceiling, High wall)

Test run is unavailable: Indoor units other than the above-mentioned indoor units.

Note 2) The forced test run by this setting cannot be cleared on the indoor remote controller.

Be sure to clear the test run by operation of the outdoor unit. (Push SW801 again for 1 second.)

SW804	Operation when pushdown button switch SW801 is pushed	
	4-way valve relay operation (For RY700, CN70 check) Turn on 4-way valve power relay (RY700). When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control. **[NOTE]** In case of these models adopting the self hold valve, the coil develops fever. Therefore do not perform this operation as coil is connected.	
	Self-hold valve suction operation (Exchange to heating cycle) (For RY700 RY701, RY705, CN701 check) Turn on relay RY700, RY701, RY705. (CN701 between ① and ④ : Voltage=Approx. +198 to 380V) This function works for 10 seconds and then is OFF.	
	Self-hold valve separation operation (Exchange to cooling cycle) Turn on relay RY700. (CN701 between 1) and 4): Voltage=Approx. –198 to 380V) This function works for 10 seconds and then is OFF.	
	SV valve relay operation (For RY702, CN702 check) Turn on SV valve relay (RY702). When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control. * For these models, the part is not mounted, so do not operate.	**[CAUTION]** Although these operations can be performed even during operation, basically perform operation while the unit stops. If performing this operation during driving the unit, it is dangerous because the pressure may change suddenly.
	Heater output relay operation (For check RY703, CN703 check) Turn on relay for option heater (RY703). When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control.	
	Outside output relay operation (RY704, CN704) Turn on relay for outside output (RY704). When pushing SW801 again or when 2 minutes elapsed, the operation returns to the normal control.	
	(No operation especially)	
	Relay operation change for outside output **[CAUTION]** Do not use this setting.	

<Maintenance/Check list>

Aiming in environmental preservation, it is strictly recommended to clean and maintain the indoor/outdoor units of the operating air conditioning system regularly to secure effective operation of the air conditioner.

It is also recommended to maintain the units once a year regularly when operating the air conditioner for a long time.

Check periodically signs of rust or scratches, etc. on coating of the outdoor units.

Repair the defective position or apply the rust resisting paint if necessary.

Although the customer has to pay the charge for the maintenance, the life of the unit can be prolonged.

Failure to clean the indoor/outdoor units regularly will cause shortage of capacity, freezing, water leakage or trouble on the compressor.

Periodic Maintenance - periodic maintenance is recommended to ensure proper operation of the unit.

Recommended maintenance intervals may vary depending on the installation environment, e.g. dusty zones, etc.

Refer to table below.

Periodic Maintenance

INDOOR UNIT	EVERY MONTH	EVERY 4 MONTHS	EVERY YEAR
Clean Air Filter *1	1		
Clean Drain Pan		1	
Clean indoor heat exchanger *2			1
Clean fan *2			1
Change Remote Control Batteries			1
INDOOR UNIT	**EVERY MONTH**	**EVERY 4 MONTHS**	**EVERY YEAR**
Clean Outdoor Coil from Outside			
Clean Outdoor Coil from Inside *2			
Blow Air Over Electric Parts *2			
Check Electric Connection Tightening *2			
Clean Fan Wheel *2			
Check Fan Tightening *2			
Clean Drain Pans *2			

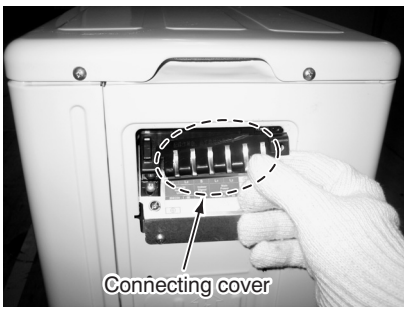
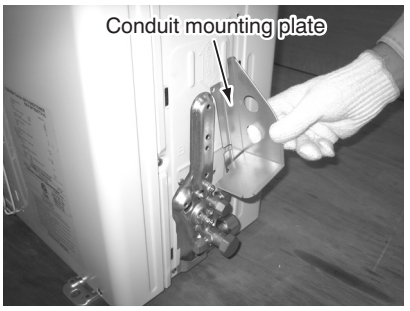
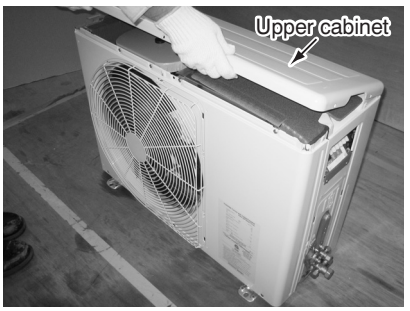
∗1: Increase frequency in dusty zones.

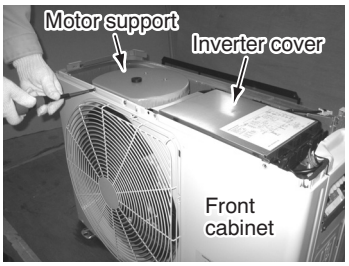
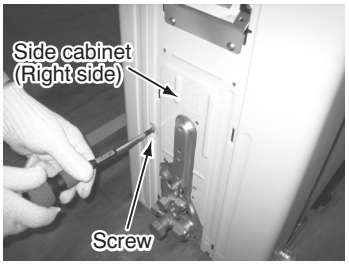
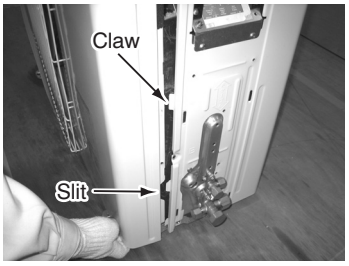
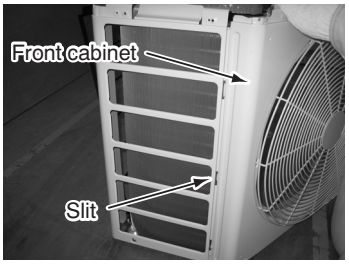
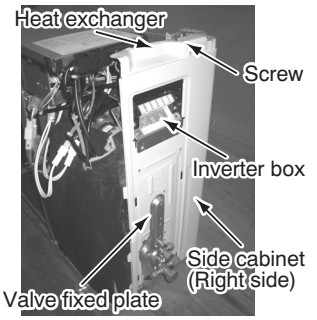
∗2: Maintenance to be carried out by qualified service personal Refer to the Installation Manual.

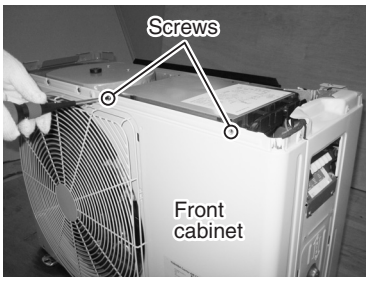
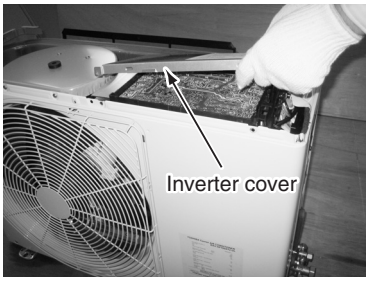
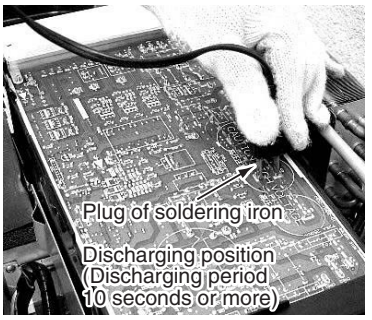
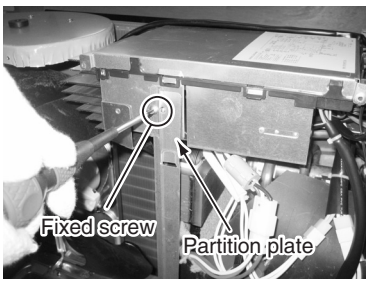
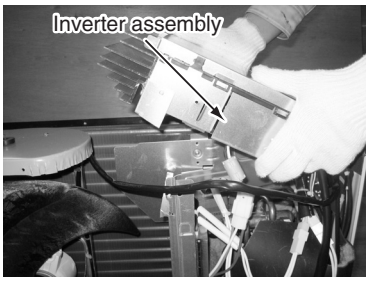
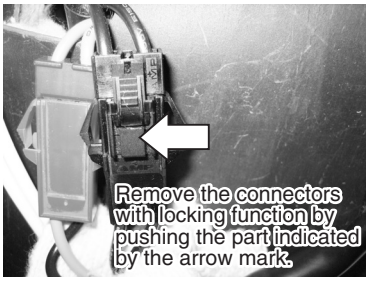
11. DETACHMENTS

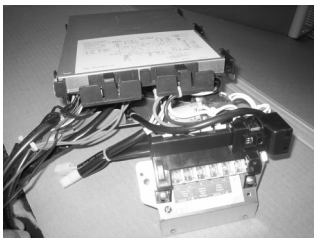
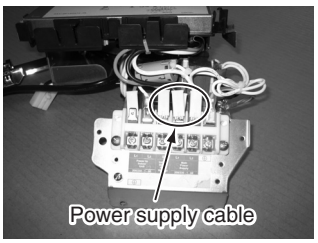
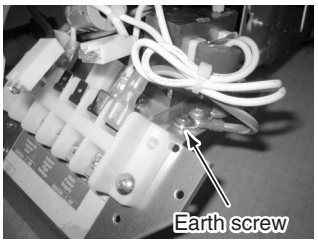
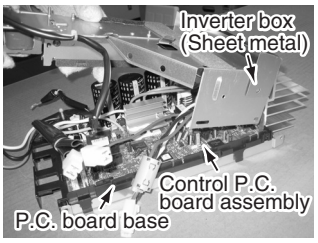
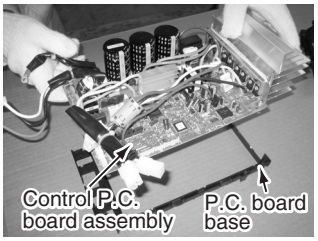
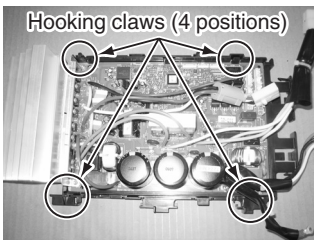
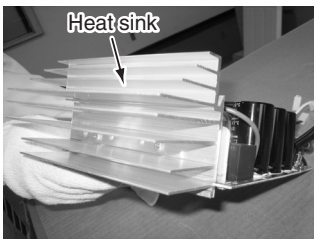
11-1. Outdoor Unit

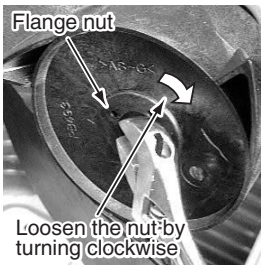
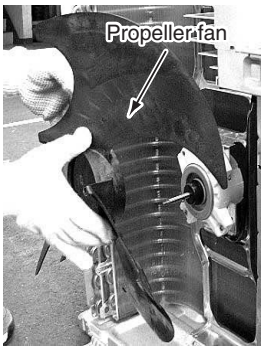
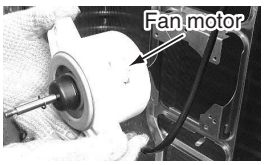
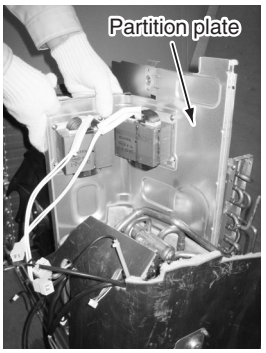
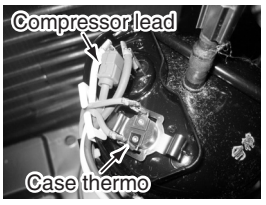
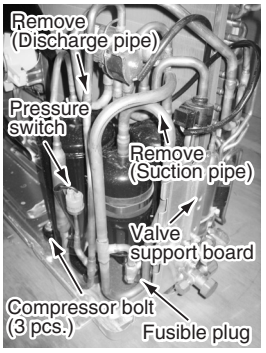
11-1-1. RAV-SP180AT2-UL

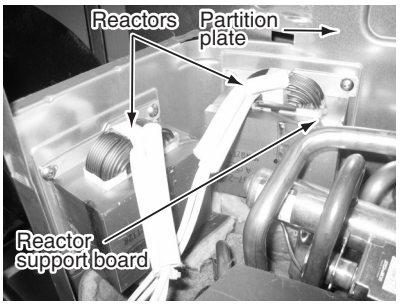
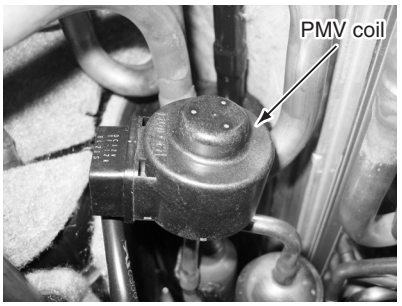
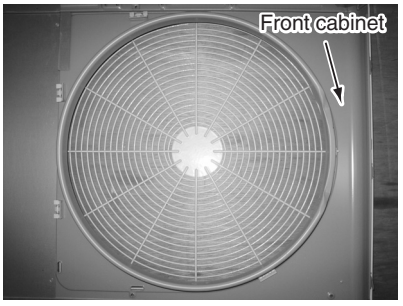
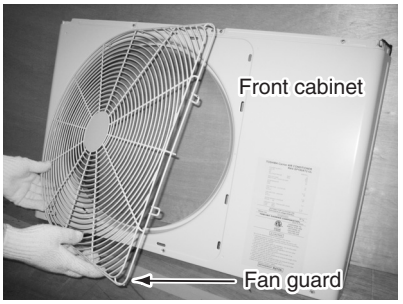
No.	Part name	Procedure	Remarks
①	Common procedure	**CAUTION** Never forget to put on the gloves at working time, otherwise an injury will be caused by the parts, etc. **1. Detachment** 1) Stop operation of the air conditioner, and turn off the main switch of the breaker for air conditioner. 2) Remove the valve cover. (M4, 8 mm, 3 pcs.) • After removing screw, remove the valve cover pulling it downward. 3) Remove connecting cable. 4) Remove the conduit mounting plate by taking off 2 screws. (M4, 8 mm, 2 pcs.) 5) Remove the upper cabinet. (M4, 8 mm, 5 pcs.) • After taking off screws, remove the upper cabinet pulling it upward. 6) Remove the waterproof cover. **2. Attachment** 1) Attach the waterproof cover. **CAUTION** Be sure to attach a waterproof cover. If it is not attached, there is a possibility that water enters inside of the outdoor unit. 2) Attach the upper cabinet. (M4, 8 mm, 5 pcs.) 3) Attach the conduit mounting plate. (M4, 8 mm, 2 pcs.) 4) Perform cabling of connecting cables. 5) Attach the valve cover. (M4, 8 mm, 3 pcs.) • Insert the upper part of the upper cabinet, set hooking claw of the valve cover to the slit (at three positions) of the main body, and then attach it pushing upward.	   

No.	Part name	Procedure	Remarks
②	Front cabinet	**1. Detachment** 1) Perform work of Detachment 1 of ① . 2) Remove screws (M4, 8 mm, 2 pcs.) of the front cabinet and the inverter cover. 3) Take off screws of the front cabinet and the bottom plate. (M4, 8 mm, 3 pcs.) 4) Take off screws of the front cabinet and the motor support. (M4, 8 mm, 2 pcs.) 5) Take off screws of the front cabinet and side cabinet (Right). (M4, 8 mm, 1 pc.) • The left side of the front side if made to insert to the rear cabinet, so remove it pulling upward. **2. Attachment** 1) Insert hook at the left side of the front side into the rear cabinet. 2) Hook the lower part at the right side of the front to concavity of the bottom plate. Insert the hook of the rear cabinet into the slit of the front cabinet. 3) Attach the removed screws to the original positions.	   
③	Side cabinet (Right)	1) Perform works of Detachment 1 of ① and ②. 2) Take off screw of the side cabinet (Right) and the heat exchanger. (M4, 8 mm, 1 pc.) 3) Take off fixed screws between the main unit and the inverter box. (Wiring port side) (M4, 8 mm, 2 pcs.) 4) Take off screws of the side cabinet (Right) and the bottom plate. (M4, 8 mm, 2 pcs.) 5) Take off screw of the side cabinet (Right) and the valve fixed plate. (M4, 8 mm, 1 pc.)	

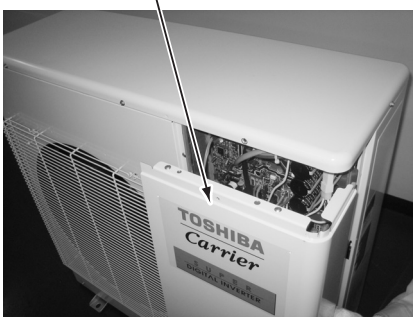
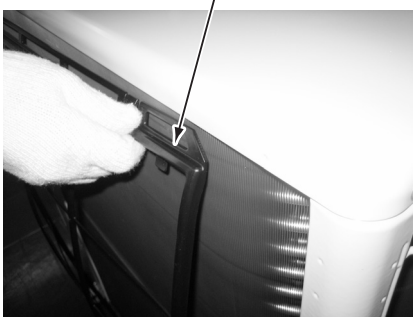
No.	Part name	Procedure	Remarks
④	Inverter assembly	**1. Turn off the power supply.** 1) Perform work of Detachment 1 of ① . 2) Take off screws, which fix the upper part of the front cabinet and the inverter cover. (M4, 8 mm, 2 pcs.) • If removing the inverter cover under the above condition, P.C. board can be checked. **⚠ ELECTRIC SHOCK** The control circuits (including each sensor circuit and 5V, 12V of PMV circuit, etc.) of this control P.C. board are high-voltage circuits. Before work, be sure to turn off the power supply. Take sufficient care to an electric shock on the control circuits and the conductive parts of their parts. 3) Using the discharging resistor (100Ω/40W or equivalent) or plug of the soldering iron, electrify continuously between ⊕ and ⊖ poles of the electrolytic capacitor of 3 phases: C10, 11 and single phase: C12, 13, 14 ("CAUTION HIGH VOLTAGE" is printed) on P.C. board, and then discharge power. For the products that the rear side are coated, perform normal discharge. **NOTES:** According to the trouble condition, the electrolytic capacitor may not normally discharge and the voltage may remain. Therefore be sure to discharge the capacitor. As the electrolytic capacitor is one with a large capacity, never use a screwdriver and others for short-circuiting between ⊕ and ⊖ electrodes for discharging; otherwise it is very dangerous because a large electric spark will generate. 4) Perform works Detachment 1 of ② and ③ . 5) Take off fixing screw between the partition plate and the inverter box. (M4, 8 mm, 1 pc.) 6) Remove various lead wires from the holder at upper part of the inverter box. 7) Pull the inverter box upward. In this time, cut the bundling bands which bind each lead wire. 8) Remove connectors of various lead wires. **NOTE:** When removing the connectors, do not hold lead wires by hands, but hold the connectors.	     

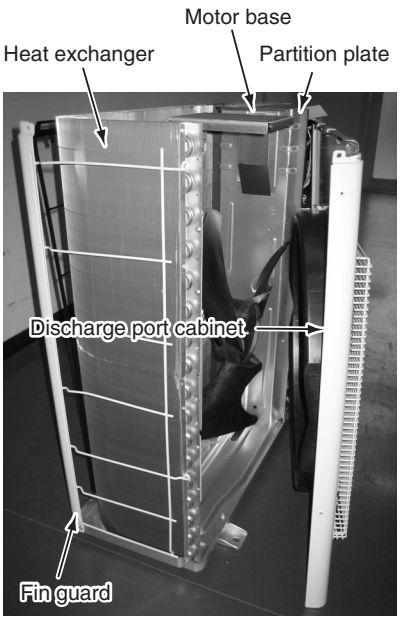
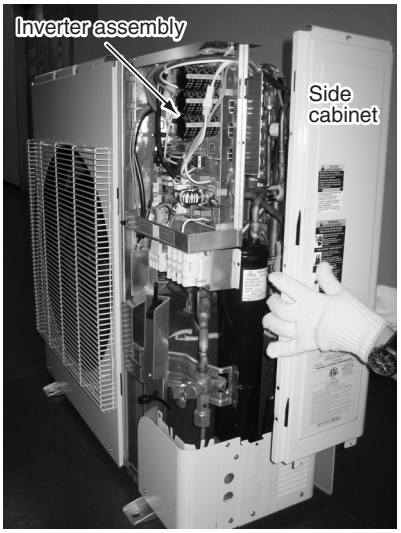
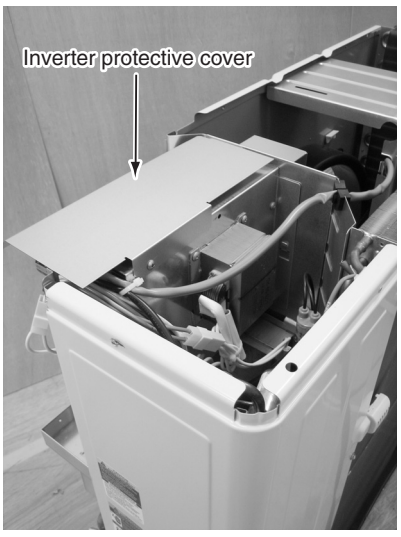
No.	Part name	Procedure	Remarks
⑤	Control P.C. board assembly	1) Remove the sub-board base from the inverter assembly. (M4, 8 mm, 2 pcs.) • Remove connector at the control P.C. board assembly side. 2) Remove the lead wires and connectors that are connected from the control P.C. board assembly to the other parts. 1. Lead wires: Connected to the power supply terminal block; 3 pcs. Black, White, Orange (Single phase), Red, White, Black, Orange (3 phases) Earth wire (Black); 1 pc 2. Connector Connected to compressor; (3P: Relay connector White) Reactor (2P: Relay connector White) ∗ (NOTE 1) CN300; Outdoor fan (3P: White) ∗ (NOTE 1) CN701; 4-way valve (3P: Yellow) ∗ (NOTE 1) CN700; PMV coil (6P: White) CN601; TD sensor (3P: White) CN603; TS sensor (3P: White) ∗ (NOTE 1) CN600; TE sensor (2P: White) ∗ (NOTE 1) CN602; TO sensor 2P: White) CN500; Case thermo + Pressure SW (2P: Blue) ∗ (NOTE 1) CN605; Sub SW P.C. base (3P: Black) **NOTE 1):** Unlock the lock of the housing part and then remove the connector. 3) Remove the inverter box (Sheet metal). 4) Remove the control P.C. board assembly from P.C. board base. (For the heat sink and the control P.C. board assembly, remove them as they are screwed.) **NOTE 2):** Take off claws (4 positions) of P.C. board base, hold the heat sink and then remove it upward. 5) Take off 2 screws that fix the heat sink and the control P.C. board assembly. 6) Mount a new control P.C. board assembly. **NOTE 3):** Mount a new control P.C. board assembly while it is correctly inserted in the P.C. board-receiving groove. Mount it so that the heat sink surely contact with the sheet metal.	      

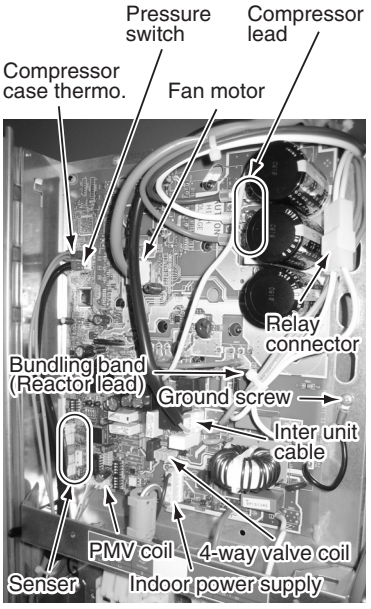
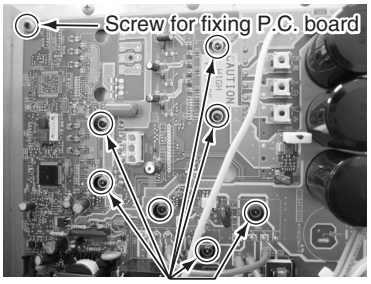
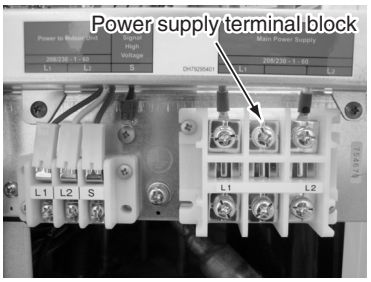
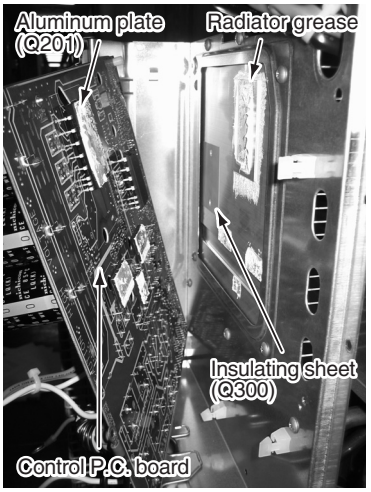
No.	Part name	Procedure	Remarks
⑥	Fan motor	1) Perform works of Detachment 1 of ① and ② . 2) Take off the flange nut fixing the fan motor and the propeller. • Turning it clockwise, the flange nut can be loosened. (To tighten the flange nut, turn counterclockwise.) 3) Remove the propeller fan. 4) Disconnect the connector for fan motor from the inverter. 5) Take off the fixing screws (2 pcs.) holding by hands so that the fan motor does not fall. **NOTE:** Tighten the flange nut with torque 4.9Nm (50kgf/cm).	  
⑦	Compressor	1) Perform works of Detachment 1 of ① , ② , ③ and ④ . 2) Discharge refrigerant gas. 3) Remove the partition plate. (M4, 8 mm, 3 pcs.) 4) Remove the noise-insulator. 5) Remove the terminal covers of the compressor, and disconnect lead wires of the compressor and the compressor thermo assembly from the terminal. 6) Remove pipes connected to the compressor with a burner. **CAUTION** Pay attention to that flame does not involve 4-way valve, PMV, pressure SW, or fusible plug. (If doing so, a malfunction may be caused.) 7) Remove the side cabinet (Left). (M4, 8 mm, 3 pcs.) 8) Take off the fixing screws of the bottom plate and heat exchanger. (M4, 8 mm) 9) Take off the fixing screws of the valve clamping plate to the bottom plate. (M4, 8 mm, 1 pc.) 10) Pull upward he refrigerating cycle. 11) Take off nut fixing the compressor to the bottom place. **CAUTION** When reconnecting the lead wires to the compressor terminals after replacement of the compressor, be sure to caulk the Faston terminal without loosening.	  

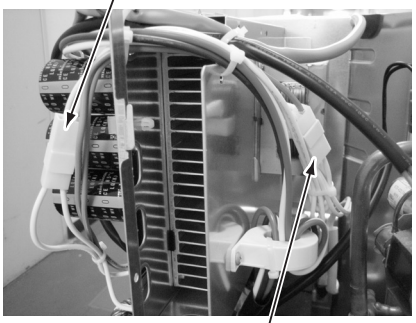
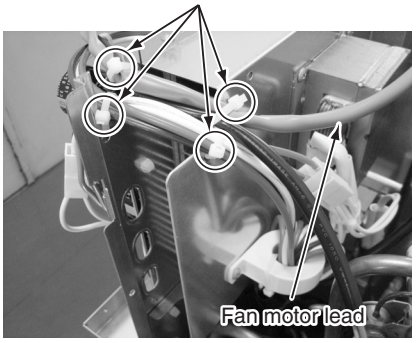
No.	Part name	Procedure	Remarks
⑧	Reactor	1) Perform works of Detachment 1 of ① , ② , ③ and ④ . 2) Take off the fixing screw for the reactor. (M4, 8 mm)	
⑨	Pulse Motor Valve (PMV) coil	**1. Detachment** 1) Perform works of Detachment ① and ② . 2) Release the coil from the concavity by turning it, and remove coil from the PMV. **2. Attachment** 1) Put the coil deep into the bottom position. 2) Fix the coil firmly by turning it to the concavity.	
⑩	Fan guard	**1. Detachment** 1) Perform works of Detachment 1 of ① and ② . 2) Remove the front cabinet, and put it down so that fan guard side directs downward. **CAUTION** Perform works on a corrugated cardboard, cloth, etc. to prevent flaw on the product. 3) Remove the fan guard stopper. (4 positions) **2. Attachment** 1) Insert the fan guard stopper and then fix the fan guard. (4 positions) **CAUTION** All the attaching works have completed. Check that all the hooking claws and the fan guard stopper are fixed to the specified positions.	 

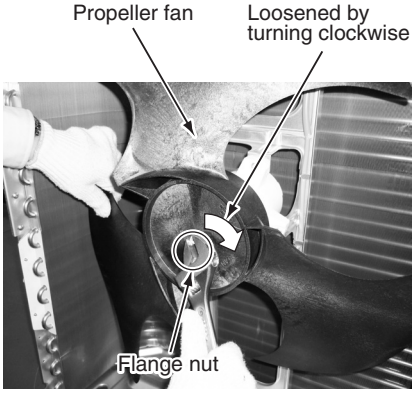
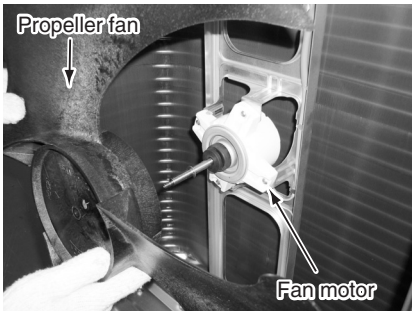
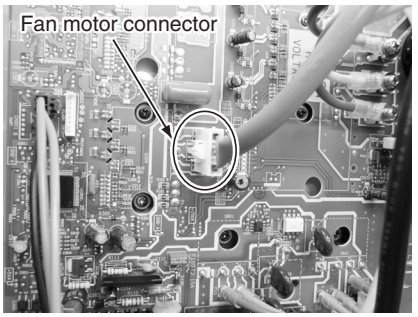
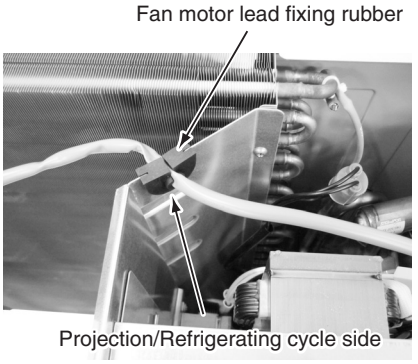
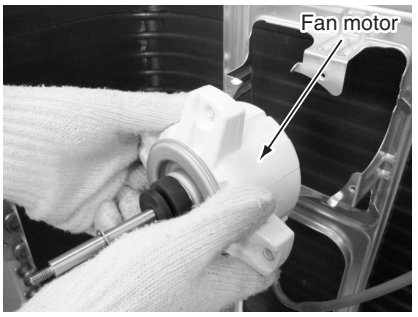
11-1-2. RAV-SP240AT2-UL

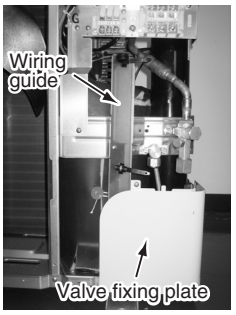
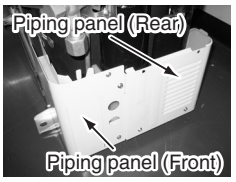
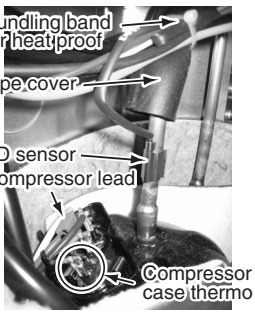
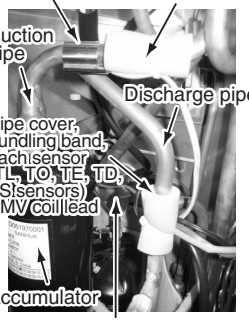
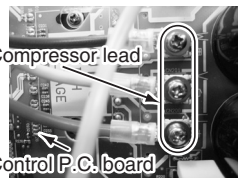
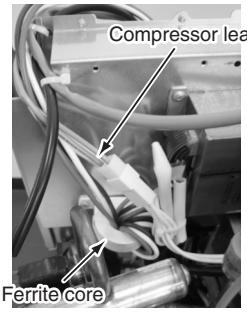
No.	Part name	Procedure	Remarks
①	Common procedure	**CAUTION** Be sure to put on the gloves at working time; otherwise an injury may be caused by a part, etc. **1. Detachment** 1) Stop operation of the air conditioner and then turn off switch of the breaker. 2) Remove the front panel. (Hexagonal screw M4, 10 mm, 2 pcs.) ∗ After removing screws, remove the front panel while pulling it downward. 3) Remove the power wire and indoor/outdoor connecting wire from the cord clamp and the terminals. 4) Remove the top plate. (Hexagonal screw M4, 10 mm, 5 pcs.) **2. Attachment** 1) Attach the top plate. (Hexagonal screw M4, 10 mm, 5 pcs.) In this time, insert the fin guard of rear side between the top plate and the heat exchanger (Rear side). 2) Connect the power supply wire and the indoor/outdoor connecting wire to the terminal and fix it with cord clamp. **CAUTION** Using bundling band on the market, be sure to fix the power wire and indoor/outdoor connecting wire along the crossover pipe so that they do not come to contact with the compressor, valve at gas side, pipe at gas side and discharge pipe. 3) Attach the front panel. (Hexagonal screw M4, 10 mm, 2 pcs.)	Front panel  Top plate Insert the fin guard of rear side between the top plate and the heat exchanger (at rear side). 

No.	Part name	Procedure	Remarks
②	Discharge port cabinet	**1. Detachment** 1) Perform work of Detachment 1 of ① . 2) Remove screws for the discharge port cabinet and the partition plate. (M4, 8 mm, 3 pcs.) 3) Remove screws for the discharge port cabinet and the bottom plate. (Hexagonal screw M4, 10 mm, 2 pcs.) 4) Remove screws of the discharge port cabinet and the motor base. (M4, 8 mm, 2 pcs.) 5) Remove screws of the discharge port cabinet and the heat exchanger. (M4, 8 mm, 1 pc.) 6) Remove screws of the discharge port cabinet and the fin guard. (Hexagonal screw M4, 10 mm, 2 pcs.)	
③	Side cabinet	1) Perform work of Detachment 1 of ① . 2) Remove screws which fix the inverter assembly and the side cabinet. (M4, 8 mm, 2 pcs.) 3) Remove screws of the side cabinet and the valve fixing plate. (M4, 8 mm, 2 pcs.) 4) Remove screws of the side cabinet and the pipe panel (Rear). (Hexagonal screw M4, 10 mm, 2 pcs.) 5) Remove screws of the side cabinet and the bottom plate. (Hexagonal screw M4, 10 mm, 1 pc.) 6) Remove screws of the side cabinet and the heat exchanger. (Hexagonal screw M4, 10 mm, 3 pcs.) 7) Slide the side cabinet upward and then remove it. (Hook of inverter)	
④	Inverter protective cover	1) Perform work of Detachment 1 of ① . 2) Take off screw which fixes the inverter assembly and the inverter protective cover. (M4, 8 mm, 1 pc.)	

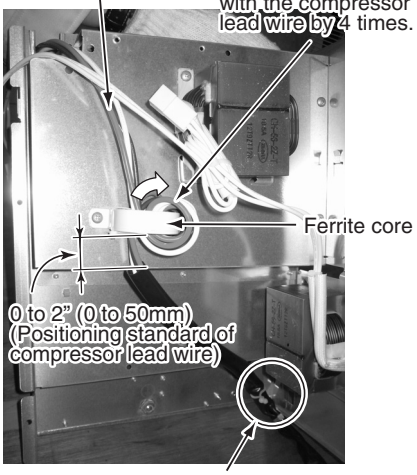
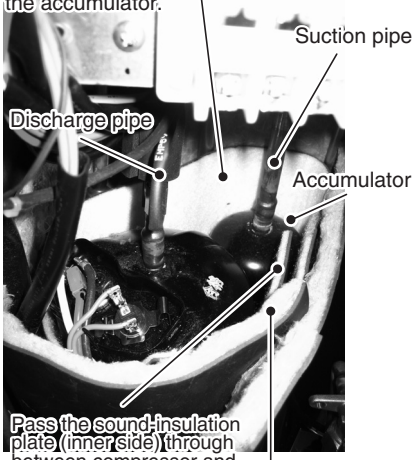
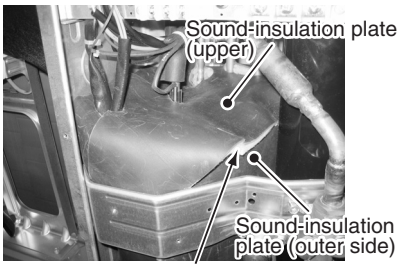
No.	Part name	Procedure	Remarks
⑤	Exchange of electric parts	**1. Control P.C. board** 1) Perform work of Detachment 1 of ① and ④ . **⚠ WARNING** Never disassemble the inverter for 1 minute after power has been turned off because an electric shock may be caused. 2) Remove the connectors connected to the control P.C. board. (Indoor power supply, temperature sensors, PMV coil, 4-way valve coil, compressor case thermo, fan motor, reactor, pressure switch.) ∗ Unlock the lock of the housing part and then remove the connectors. 3) Remove the lead wires connected to the control P.C. board. (Torque at tightening time: 1.47 ± 0.1N•m) Compressor lead U: CN200 Red V: CN201 White W: CN202 Black Reactor lead Relay connector: 2 positions Remove the power wire from the power supply terminal block. (Torque at tightening time: 2.5 ± 0.1N•m) 4) Remove the earth wire from the control P.C. board. (Truss B tight screw M4, 6 mm, 1 pc.) 5) Remove the fixing screws of the control P.C. board. (Screw with collar for fixing element M3, 16 mm, 7 pcs. Pan S tight screw for fixing P.C. board M3, 20 mm, 1 pc.) 6) Remove the control P.C. board. (Supporter: 5 positions) **NOTE:** It is difficult to take out it because of radiator grease for heat sink. 7) Mount a new control P.C. board. **NOTE:** Do not forget to attach the aluminum plate (Q201) and the insulating sheet (Q300). (Applying a little of radiator grease at the rear surface of the insulating sheet in advance to adhere to the heat sink makes easy the work.)	  Screw for fixing element (7 positions)  

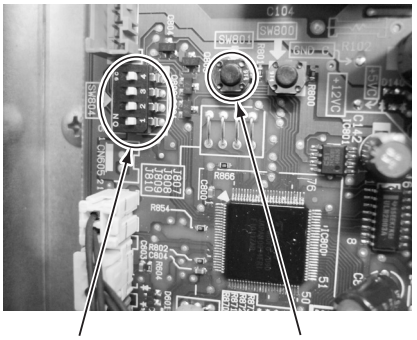
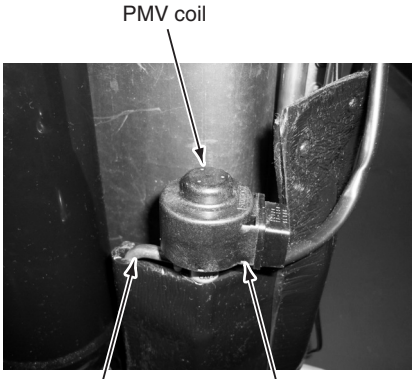
No.	Part name	Procedure	Remarks
⑤	Exchange of electric parts (Continued)	**1. Reactor** 1) Perform work of Detachment 1 of ① , ③ and ④ . 2) Remove the relay connector connected to the control P.C. board. 3) Cut off the bundling band binding the compressor lead and the relay connector. 4) Remove each reactor. (Truss B tight screw M4, 6 mm, 2 pcs. each) 5) Attach a new reactor. **NOTE:** Be sure to bind the removed bundling band with the bundling band on the market. Be careful that the fan motor lead does not come to contact with the reactor body.	Reactor relay connector (Connected to lead wire (White) at P.C. board side)  Reactor relay connector (Connected to lead wire (Charcoal gray) at P.C. board side) Bundling band (Compressor lead, reactor lead)  Upper reactor Connected to reactor relay connector (Connected to lead wire (White) at P.C. board side) Bundling band Lower reactor Connected to reactor relay connector (Connected to lead wire (Charcoal gray) at P.C. board side)

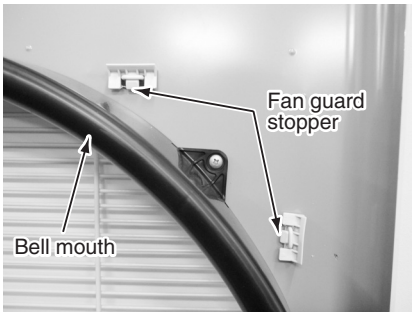
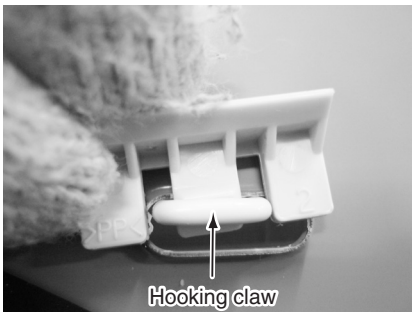
No.	Part name	Procedure	Remarks
⑥	Fan motor	1) Perform work of Detachment 1 of ① , ② , ③ and ④ . 2) Remove the flange nut fixing the fan motor and the propeller fan. ∗ The flange nut is loosened by turning clockwise. (To tighten it, turn it counterclockwise.) 3) Remove the propeller fan. 4) Remove the connector for fan motor from the inverter. 5) Remove the fan motor lead from the fan motor lead fixing rubber of the penetrated part of the partition plate. 6) Remove the fixing screws (4 pcs. each) while supporting the fan motor so that it does not fall. **∗ Cautions when assembling the fan motor** ∗ Tighten the flange nut with 4.95N•m (50kgf.cm). ∗ Adjust length on the fan motor lead fixing rubber so that the fan motor lead does not slacken in order not to put the fan motor lead into contact with the propeller fan. Attach the fan motor lead fixing rubber to the partition plate so that projection directs to the refrigerating cycle side. ∗ Be sure that the rector body does not come to contact with the fan motor lead. ∗ Be sure to bind the removed bundling band with the bundling band on the market. **⚠ CAUTION** Use the metal band of the motor base to fix the fan motor lead on the motor base so that the fan motor lead does not come to contact with the propeller fan.	    

No.	Part name	Procedure	Remarks
⑦	Compressor Compressor lead	**1. Removal of broken compressor** 1) Recover the refrigerant gas. 2) Perform work of Detachment 1 of ① , ② , ③ and ④ . 3) Remove the wiring guide (vertical). Take off screw of the wiring guide (vertical) and volve fixing plate. (M4, 8 mm, 1 pc.) Take off screw of the wiring guide (vertical) and piping panel (Front). (M4, 8 mm, 1 pc.) 4) Remove the wiring division panel. Take off screw of the wiring division panel and the inverter assembly. (M4, 8 mm, 1 pc.) Take off screw of the wiring division panel and the valve fixing plate. (M4, 8 mm, 1 pc.) 5) Remove the piping panel (Front). Remove screws of the piping panel (Front) and the bottom plate. (Hexagonal screw M4, 10 mm, 2 pcs.) Remove screws of the piping panel (Front) and the piping panel (Rear). (Hexagonal screw M4, 10 mm, 1 pc.) 6) Remove the piping panel (Rear). Remove screws of the piping panel (Rear) and the bottom plate. (Hexagonal screw M4, 10 mm, 2 pcs.) 7) Remove the valve fixing plate. Remove bolts of the valve. (Hexagonal screw M6, 15 mm, 4 pcs.) Remove screws of the valve fixing plate and the partition plate. (M4, 8 mm, 1 pc.) Remove screws of the valve fixing plate and the accumulator. (M4, 8 mm, 1 pc.) Cut off the bundling band for the discharge pipe and the suction pipe and then remove each sensor and coil lead of PMV. 8) Remove the sound insulating plate. (Upper side, outer winding, inner winding) 9) Remove terminal cover from the compressor and then remove the compressor lead and also the compressor case thermo. 10) Remove TD sensor fixed to the discharge pipe. 11) Remove the compressor lead. (Leave the ferrite core attached to the electric parts box as it is.) **Control P.C. board** U : CN200 Red V : CN201 White W : CN202 Black (Tightening torque: 1.47 ± 0.1 N•m)	    Black pipe cover for heat proof, bundling band for heat proof, each sensor (TL, TO, TE, TD, TS sensors) PMV coil lead  

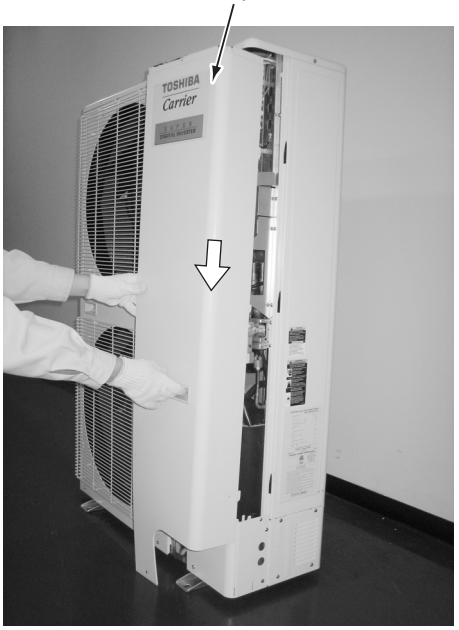
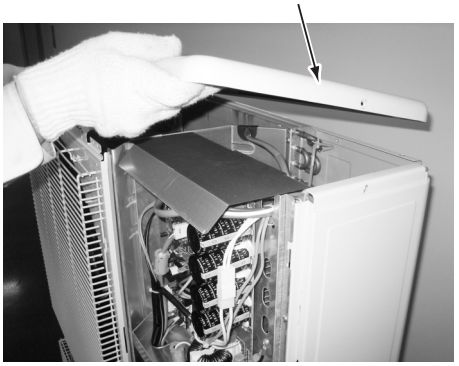
No.	Part name	Procedure	Remarks
⑦	Compressor Compressor lead (Continued)	12) Using a burner, remove the discharge pipe and the suction pipe connected to the compressor. **⚠ WARNING** In case of removing the piping by broiling the welded part with a burner, if the piping includes oil, it may burst into flames at the moment when wax melted, so take sufficient care. **⚠ CAUTION** Note so that the frame does not catch the 4-way valve, PMV and pressure switch. (An operation may become an error.) 13) Pull off the discharge pipe and the suction pipe of the refrigerating cycle upward. 14) Remove the compressor bolts which fix the compressor to the bottom plate. (3 pcs.) 15) Pull out the compressor toward you. **⚠ CAUTION** The weight of the compressor is 15kg or more, so handle it by 2 workers.	

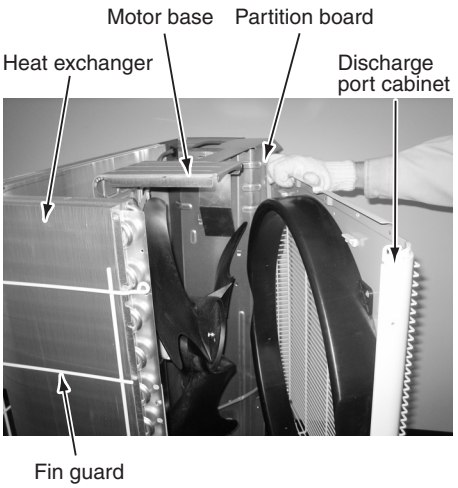
No.	Part name	Procedure	Remarks
⑦	Compressor Compressor lead (Continued)	**2. Mounting of compressor** 1) Mount the compressor in the reverse procedure of removal. **NOTES:** * After exchange of the compressor, be sure to exchange the compressor lead. (Repair part code of compressor lead: 43160591) In this time, wrap the ferrite core with the compressor lead wire by 4 times. Using bundling band on the market, bind the compressor lead. As the compressor lead is long, be sure that the compressor lead does not contact with the discharge pipe. * Fix the removed each sensor and PMV coil lead wire to the discharge pipe and the suction pipe with the bundling band via the pipe cover. In this time, take note that each sensor and PMV coil lead wire do not come to contact with the discharge pipe and the reactor. (For fixing to the discharge pipe, use the black heat-proof pipe cover and the bundling band for heat-proof which is sold on the market.) * As shown in the right figure, mount the sound-insulation plate (inner side, outer side) by inserting between the compressor and the piping, and between piping and the partition plate. * Put the compressor lead wire and the compressor case thermo between inner side and outer side of the sound-insulation as if dropping them in.	 Using the bundling band on the market, fix the bundle at 2 positions. Pass the sound-insulation plate (outer side) through between the suction pipe and the accumulator.  Put the sound-insulation plate (outer side) on the other side at this position. Pipe cover, bundling band, TS sensor Set each sensor so that it does not come to contact with the discharge pipe. Pipe cover, bundling band, each sensor (TL, TO, TE, TS sensor) PMV coil lead  Do not make clearance between the sound-insulation plate (upper) and the sound-insulation plate (outer side).

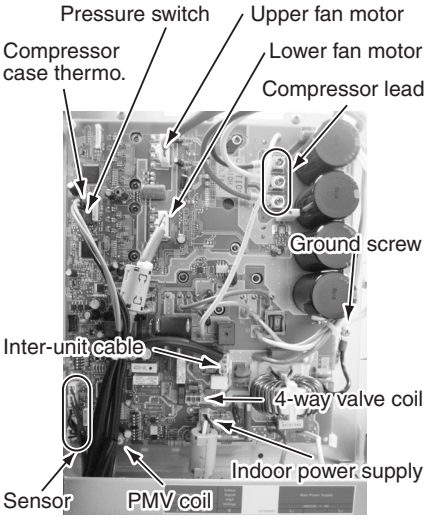
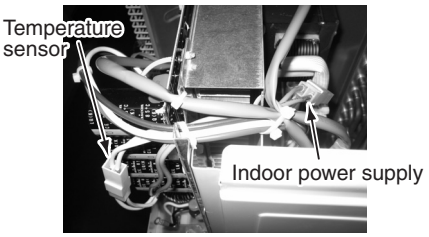
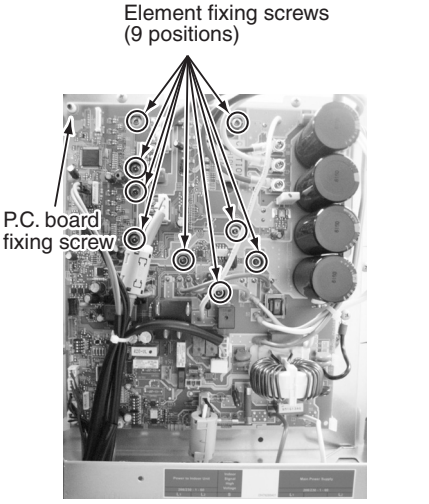
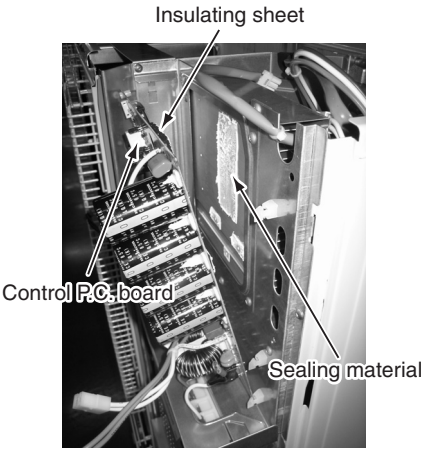
No.	Part name	Procedure	Remarks
⑦	Compressor Compressor lead (Continued)	**3. Vacuuming** 1) Connect the vacuum pump to the charge port of the gas pipe valve and then drive the vacuum pump. 2) Carry out vacuuming until the vacuum low pressure gauge indicates 1 (mmHg). **NOTE:** Before vacuuming, open PMV fully. If PMV is closed, vacuuming may be impossible between the liquid pipe valve and PMV of the outdoor unit. **Forced full-opening method of PMV** ∗ Turn on the leakage breaker. ∗ Turn on 1 and 3 of DIP SW804 on the control P.C. board of the outdoor unit. ∗ Keep pushing SW801 on the control P.C. board of the outdoor unit for 1 second or more. ∗ After pushing SW801 for 1 second or more, turn off the leakage breaker within 2 minutes. **4. Refrigerant charging** 1) Add the quantity of refrigerant specified by the pipe length into the charge port of the valve.	 SW804 SW801
⑧	PMV coil	**1. Detachment** 1) Perform work of Detachment ① and ③. 2) While pulling the coil upward and removing the spring which pinches the copper pipe, remove the coil from PMV main body. **2. Attachment** 1) Match the spring to the copper pipe and fix it.	 PMV coil Spring PMV main body

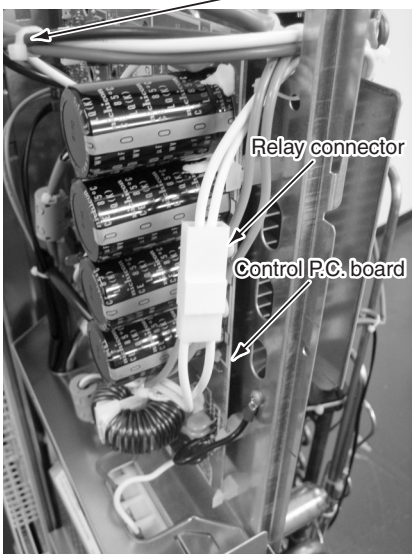
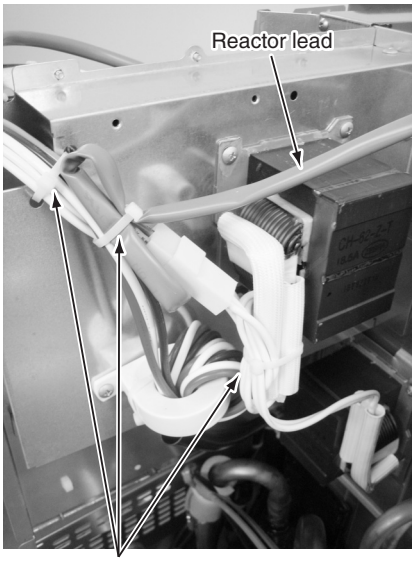
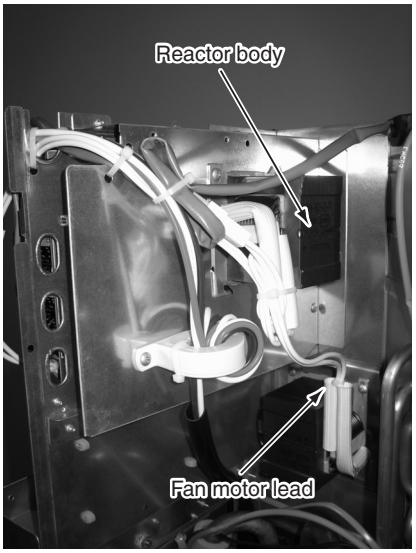
No.	Part name	Procedure	Remarks
⑨	Fan guard	**3. Detachment** 1) Perform work of Detachment ① and ②. **CAUTION** To prevent scratching on the product, handle the product on a cardboard or cloth. 2) Remove the discharge port cabinet and then put on it so that the fan guard side directs downward. 3) Remove the fan guard stopper. (8 positions) **2. Attachment** 1) Insert the fan guard stopper to fix the fan guard. (8positions) **CAUTION** Check that entire fan guard stoppers are fixed at the specified positions.	  

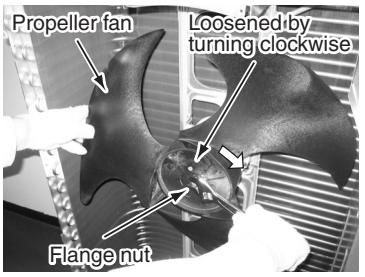
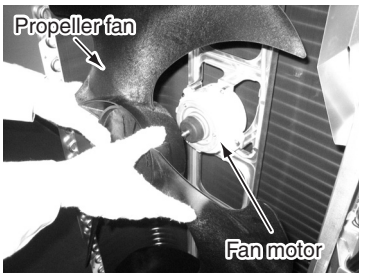
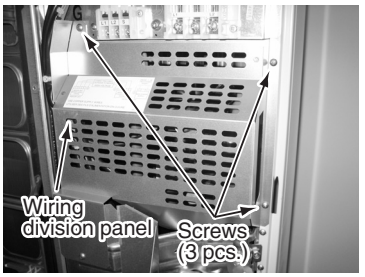
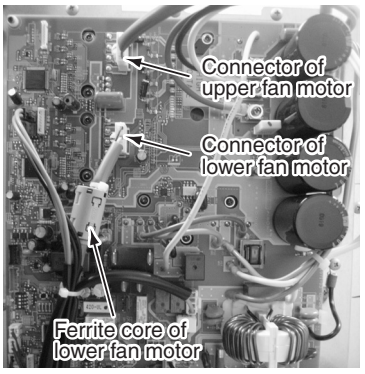
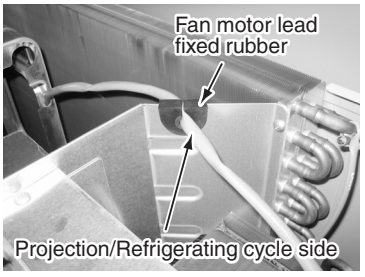
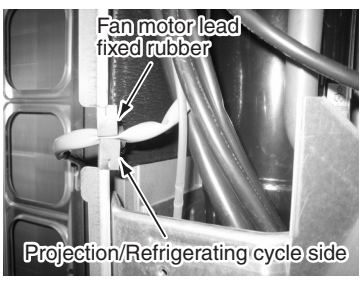
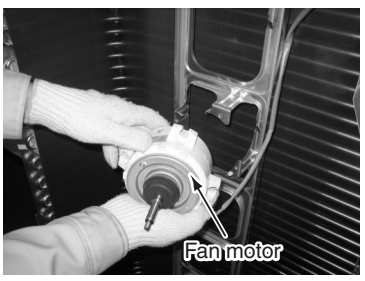
11-1-3. RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL

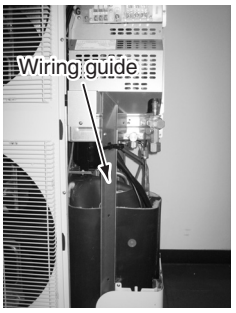
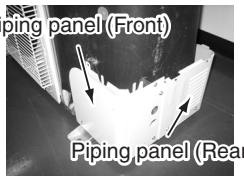
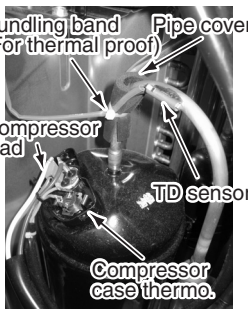
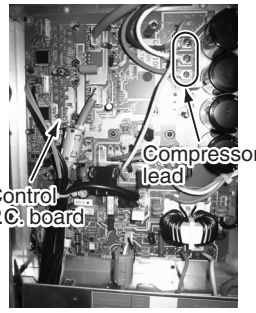
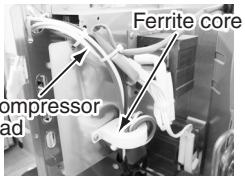
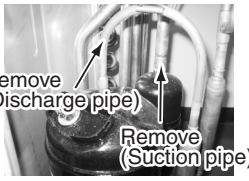
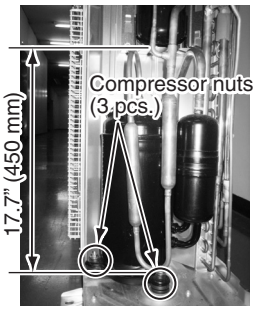
No.	Part name	Procedure	Remarks
①	Common procedure	**CAUTION** Never forget to put on the gloves at working time; otherwise an injury will be caused by the parts, etc. **1. Detachment** 1) Stop operation of the air conditioner and then turn off switch of the breaker. 2) Remove the front panel. (Hexagonal screw M4, 10 mm, 2 pcs.) • Remove the screws and then remove the front panel by pulling it downward. 3) Remove the power supply wire and the indoor/outdoor connecting wire from the cord clamp and the terminal. 4) Remove the top plate. (Hexagonal screw M4, 10 mm, 5 pcs.) **2. Attachment** 1) Attach the top plate. (Hexagonal screw M4, 10 mm, 5 pcs.) 2) Connect the power supply wire and the indoor/outdoor connecting wire to the terminal and then fix them with the cord clamp. **REQUIREMENT** For the power supply wire and the indoor/outdoor connecting wire, be sure fix them using the bundling band on the market along the crossover pipe so that they do not come to contact with the compressor, valve at gas side, pipe at gas side and discharge pipe. 3) Attach the front panel. (Hexagonal screw M4, 10 mm, 2 pcs.)	Front panel  Top plate 

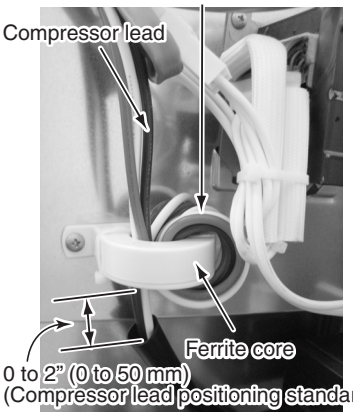
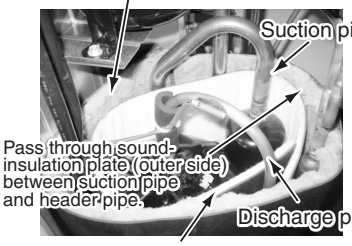
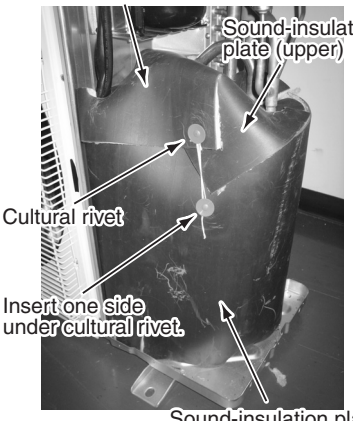
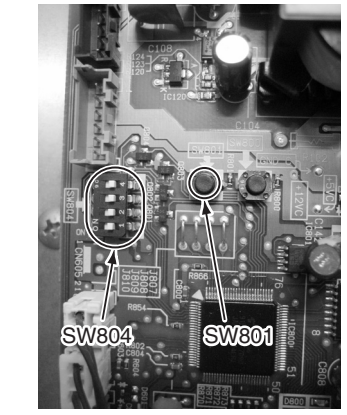
No.	Part name	Procedure	Remarks
②	Discharge port cabinet	**1. Detachment** 1) Perform work of Detachment 1 of ① . 2) Remove screws for the discharge port cabinet and the partition board. (M4, 8 mm, 4 pcs.) 3) Remove screws for the discharge port cabinet and the bottom plate. (Hexagonal screw M4, 10 mm, 2 pcs.) 4) Remove screws for the discharge cabinet and the motor base. (M4, 8 mm, 2 pcs.) 5) Remove screw for the discharge cabinet and the heat exchanger. (M4, 8 mm, 1 pc.) 6) Remove screws for the discharge port cabinet and the fin guard. (Hexagonal screw M4, 10 mm, 2 pcs.)	
③	Side cabinet	1) Perform work of Detachment 1 of ① . 2) Remove the screws which fix the inverter assembly and the side cabinet. (M4, 8 mm, 2 pcs.) 3) Take off screws that fix the wiring division panel and the side cabinet. 4) Remove the screws for the side cabinet and the valve fixing plate. (M4, 8 mm, 2 pcs.) 6) Remove screws for the side cabinet and the piping panel (Rear). (Hexagonal screw M4, 10 mm, 2 pcs.) 6) Remove screw for the side cabinet and the bottom plate. (Hexagonal screw M4, 10 mm, 1 pc.) 7) Remove screws for the side cabinet and the fin guard (Heat exchanger). (Hexagonal screw M4, 10 mm, 5 pcs.)	
④	Inverter protective cover	1) Perform work of Detachment 1 of ① . 2) Take off screw which fixes the inverter assembly and the inverter protective cover. (M4, 8 mm, 1 pc.)	

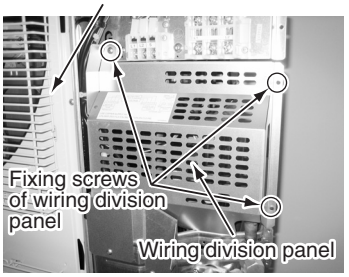
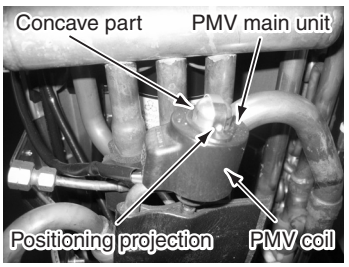
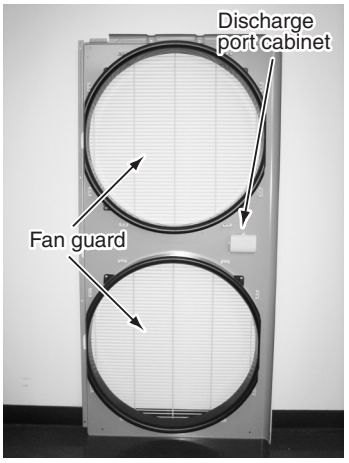
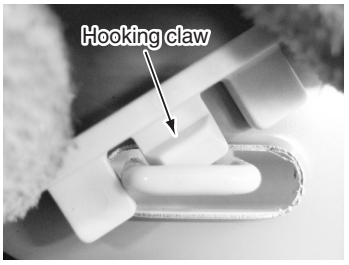
No.	Part name	Procedure	Remarks
⑤	Replacement of electric parts	**1. Control P.C. board** 1) Perform work of Detachment 1 of ① and ④ . **⚠ WARNING** Never disassemble the inverter for 1 minute after power supply has been turned off because an electric shock may be caused. 2) Remove the connectors connected to the control P.C. board. (Indoor power supply, Temperature sensor, PMV coil, 4-way valve coil, Compressor case thermo, Fan motor, reactor, pressure switch) • Unlock the lock of the housing part and then remove the connectors. 3) Remove the lead wires connected to the control P.C. board. Compressor lead U : CN200 Red V : CN201 White W : CN202 Black Reactor lead Relay connector : 2 positions 4) Remove the earth wire from the control P.C. board. (Trust B tight screw M4, 6 mm, 1 pc.) 5) Remove the fixing screws of the control P.C. board. (Screw with collar for fixing element M3, 16 mm, 9 pcs. Pan S tight screw for fixing board M3, 20 mm, 1 pc.) 6) Remove the control P.C. board. (Supporter: 5 positions) **NOTE :** Be careful to take out because there is sealing material for the heat sink. 7) Replace the control P.C. board with a new one. **NOTE :** • Be sure not to come-off of the insulating sheet.	   

No.	Part name	Procedure	Remarks
⑤	Replacement of electric parts (Continued)	**2. Reactor** 1) Perform work of Detachment 1 of ① , ③ and ④ . 2) Remove relay connector connected to the control P.C. board. (2 positions) 3) Cut the bundling band which bind compressor lead, relay connector and fan motor lead. (4 positions) 4) Remove the reactor. (Trust B tight screw, M4, 6 mm, 2 pcs.) 5) Replace the reactor with a new one. **NOTE :** Be sure to bundle the removed bundling band with the bundling band on the market. Be careful so that the fan motor lead does not come to contact with the reactor body.	Bundling band (Compressor lead, Reactor lead)   Bundling band (Compressor lead, Reactor lead) 

No.	Part name	Procedure	Remarks
⑥	Fan motor	1) Perform work of Detachment 1 of ① , ③ and ④ . 2) Remove the flange nut fixing the fan motor and the propeller fan. • The flange nut is loosened by turning it clockwise. (When tightening it, turn it counterclockwise.) 3) Remove the propeller fan. 4) Remove screws which fix the wiring division panel and the side cabinet. (M4, 8 mm, 2 pcs.) 5) Remove the connector for the fan motor from the inverter. (Remove the ferrite core of the lower fan motor because it is used.) 6) Remove the fan motor lead from the fan motor lead fixed rubber of the penetrated part of the partition board. 7) Remove the fixing screws (4 pieces each) while supporting the fan motor so that it does not fall down. ∗ Cautions for assembling of fan motor • Tighten the flange nut with 4.95N•m (50kgf•cm). • Adjust length of the fan motor lead wire at the fan motor lead fixed rubber so that the fan motor lead is not slackened; otherwise the fan motor lead may come to contact with the propeller fan. Attach the fan motor lead fixed rubber to the partition board so that the projection is set at the refrigerating cycle side. • Be sure so that the rector body does not contact with the fan motor lead. • Be sure to bundle the removed bundling band with the bundling band on the market. • Necessarily attach the ferrite core of the lower fan motor again. (Fix it with bundling band on the market.) **REQUIREMENT** Be sure to fix the fan motor lead to the motor base using the metal band of the motor base so that the fan motor lead does not come to contact with the propeller fan.	      

No.	Part name	Procedure	Remarks
⑦	Compressor Compressor lead	**1. Removal of defective compressor** 1) Recover the refrigerant gas. 2) Perform work of Detachment 1 of ① , ③ and ④ . 3) Remove the wiring guide (vertical). Take off screw of the wiring guide (vertical) and the valve fixing plate. (M4, 8 mm, 1 pc.) Take off screw of the wiring guide (vertical) and the piping panel (front). (M4, 8 mm, 1 pc.) 4) Remove the wiring division panel. Take off screws of the wiring division panel and the side cabinet. (M4, 8 mm, 2 pcs.) 5) Remove the piping panel (Front). Remove the piping panel (Front) and screws of the bottom plate. (Hexagonal screw M4, 10 mm, 2 pcs.) Remove screw of the piping panel (Front) and the piping panel (Rear). (Hexagonal screw M4, 10 mm, 1 pc.) 6) Remove the piping panel (Rear). Remove the piping panel (Rear) and screws of the bottom plate. (Hexagonal screw M4, 10 mm, 2 pcs.) 7) Remove the sound-insulation plate. (Upper, rolling in, rolling out) 8) Remove the terminal cover of the compressor and then remove the compressor lead and the compressor case thermo. 9) Remove TD sensor which is fixed to the discharge pipe. 10) Remove the compressor lead. (Leave the ferrite core as it is attached to the electric parts box.) Control P.C. board U : CN200 Red V : CN201 White W : CN202 Black 11) Using a burner, remove the discharge pipe and the suction pipe which are connected to the compressor. **⚠ WARNING** In case of removing the piping by broiling the welded part with a burner, if there is oil in the pipe, it may burst into flames at the moment that wax melted, so take sufficient care. **CAUTION** Note so that the flame does not catch the 4-way valve, PMV and pressure switch. (A malfunction may be caused.) 12) Pull off the discharge pipe and the suction pipe of the refrigerating cycle upward. 13) Remove the compressor nuts which fix the compressor to the bottom plate. (3 pcs.) 14) Pull out the compressor toward you. **CAUTION** As weight of the compressor is 44 lbs (20kg) or more, handle it by 2 workers.	      

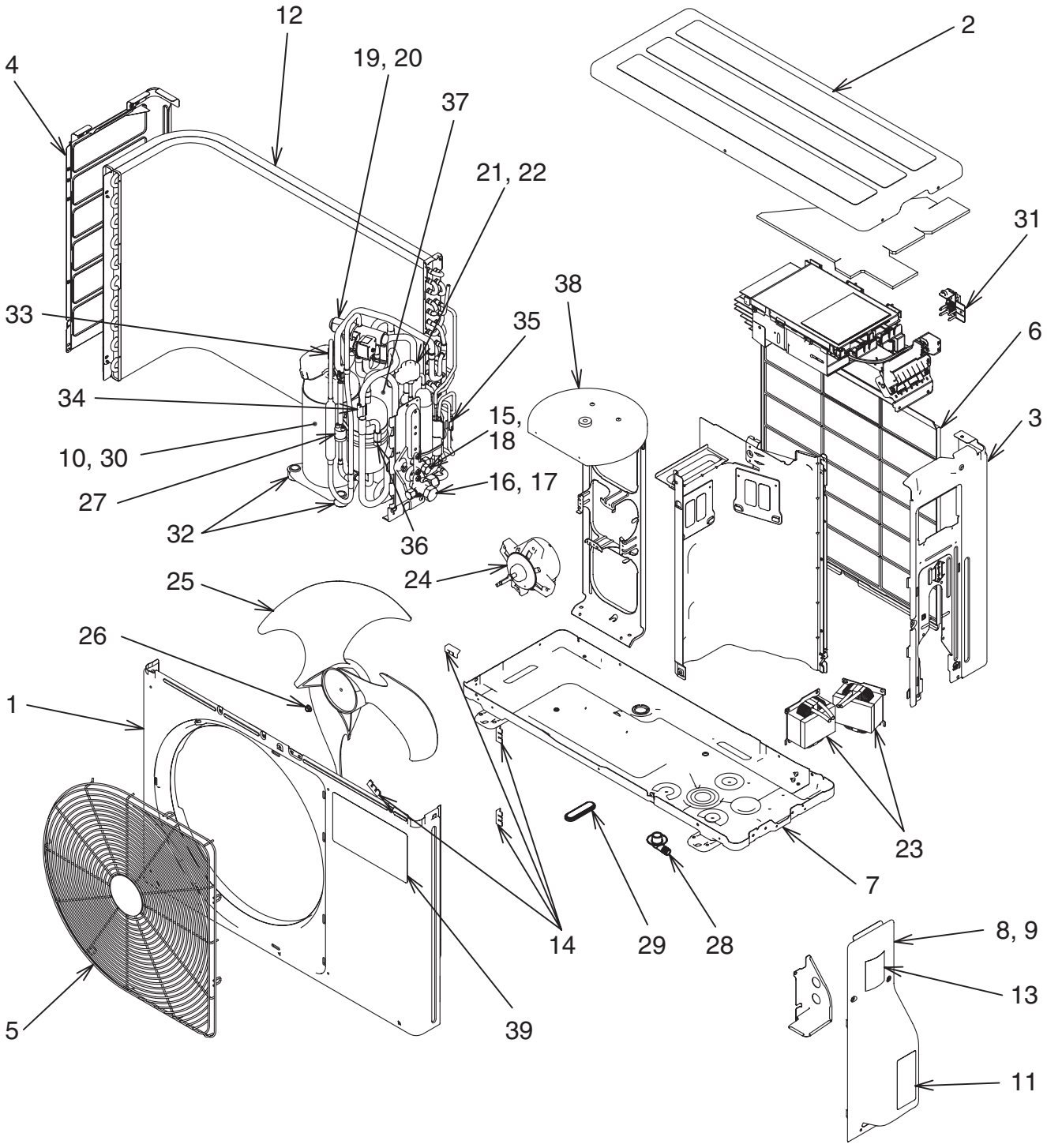
No.	Part name	Procedure	Remarks
⑦	Compressor Compressor lead (Continued)	**2. Mounting of compressor** 1) Mount the compressor in the reverse procedure for removal. **NOTE :** • After replacement of the compressor, be sure to replace the compressor lead. (Repair part code of compressor lead: 43160591) In this time, wrap the ferrite core with the compressor lead wire by 4 times. • As shown in the right figure, mount the sound-insulation plate (inner side, outer side) by passing through it between the compressor and the piping, and between the piping and the partition board. • Fix TD sensor by the bundling band for heat-proof on the market via the pipe cover so that TD sensor does not directly come to contact with the discharge pipe. **3. Vacuuming** 1) Connect the vacuum pump to the charge port and the check joint of the gas pipe valve and then drive the vacuum pump. 2) Carry out vacuuming until the vacuum low pressure gauge indicates 1 (mmHg). **NOTE :** Before vacuuming, open PMV fully. If PMV is closed, vacuum may be impossible between liquid pipe valve and PMV of the outdoor unit. Forced full-opening method of PMV • Turn on the leakage breaker. • Turn on 1 and 3 of Dip switch SW804 on the control P.C. board of the outdoor unit. • Keep pushing SW801 on the control P.C. board of the outdoor unit for 1 second or more. • After pushing SW801 for 1 second or more, turn off the leakage breaker within 2 minutes. **4. Refrigerant charge** 1) Add the refrigerant amount determined by the pipe length from the charge port of the valve.	Wrap the ferrite core with the compressor lead wire for 4 times.  Put the end of sound-insulation plate (outer side) on the other end at this position.  Pass through sound-insulation plate (inner side) between compressor and discharge pipe, suction pipe and then put the end of sound-insulation plate on the other end at this position There should be no clearance between sound-insulation plate (upper) and sound-insulation plate (outer side).  

No.	Part name	Procedure	Remarks
⑧	PMV coil	**1. Detachment** 1) Perform work of Detachment 1 of ① and ③ . 2) Take off screws that fix the wiring division panel and the side cabinet. (M4, 8 mm, 2 pcs.) 3) Turn the coil while pulling upward and then remove the coil from the PMV main unit. **2. Attachment** 1) Surely match the positioning projection of the coil with the concave part of PMV main unit and then fix it.	Discharge port cabinet  
⑨	Fan guard	**1. Detachment** 1) Perform work of Detachment 1 of ① and ② . **REQUIREMENT** To prevent scratch on the product, carry out the work on cardboard, cloth, etc. 2) Remove the discharge port cabinet and then put on it so that the fan guard side directs downward. 3) Remove the guard stopper. (8 positions × 2) **2. Attachment** 1) Insert the guard stopper to fix the fan guard. (8 positions × 2) **REQUIREMENT** Check that all the guard stopper are fixed at the specified positions.	 Bell mouth 

12. EXPLODED VIEWS AND PARTS LIST

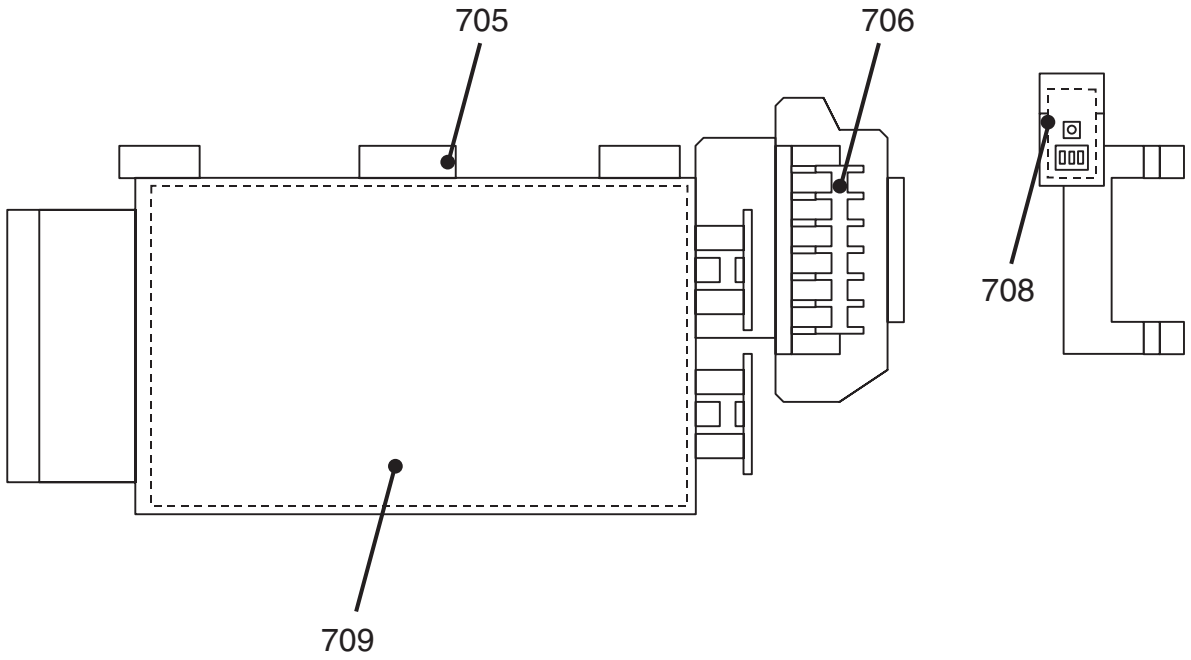
12-1. Outdoor Unit

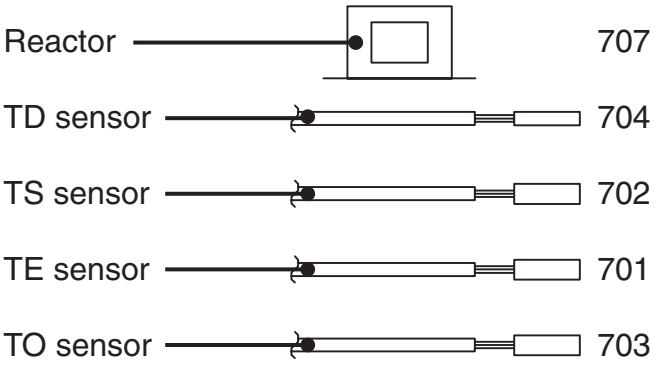
12-1-1. RAV-SP180AT2-UL



Location No.	Part No.	Description	Model Name
			RAV-SP180AT2-UL
1	43105043	Cabinet, Front	1
2	43105041	Cabinet, Upper	1
3	43105044	Cabinet, Side, Right	1
4	43005672	Cabinet, Side, Left	1
5	43119503	Guard, Fan	1
6	4301V053	Guard, Fin	1
7	43100346	Base Ass'y, RoHs	1
8	43119504	Cover, Valve, Packed Ass'y	1
9	4311M658	Lavel, Caution, Wiring	1
10	43041648	Compressor, DA150A1F-21F1	1
11	4311M656	Lavel, Warning	1
12	4314G281	Condenser Ass'y	1
13	4311M655	Lavel, Caution, Refrigerant	1
14	43107284	Stopper, Guard, Fan	4
15	37546845	Valve, Packed, 6.35	1
16	43146680	Valve, Packed, 12.7	1
17	43147195	Bonnet, 1/2 IN	1
18	43147196	Bonnet, 1/4 IN	1
19	43146740	Valve, 4-Way, STF-02U13Z	1
20	43146739	Coil, STF-01AQ503UC1	1
21	4314N034	Valve, Pulse, Modulating, CAM-BD18TF-1	1
22	43046487	Coil, PMV, CAM-MD12TF-12	1
23	43058277	Reactor, CH-57-Z-T	2
24	4312C063	Motor, Fan, ICF-340UA40-1	1
25	43020329	Fan, Propeller, PJ421	1
26	43047669	Nut, Flange	1
27	43151305	Switch, Pressure Ass'y, ACB-4UB82W	1
28	43032441	Nipple, Drain	1
29	43089160	Cap, Waterproof	2
30	43150340	Compressor, Thermostat Ass'y, US-622KXTMQO-SS	1
31	43063339	Holder, Sensor (TO)	1
32	43042485	Rubber, Cushion	3
33	43063321	Holder, Sensor, 4-8, 9.52	1
34	43063322	Holder, Sensor, 6-11.4, 12.7	1
35	43063325	Holder, Sensor, 6-6.35, 8	1
36	43148220	Plug, Fusible	1
37	43148205	Accumulator Ass'y, 1L	1
38	43039392	Base, Motor	1
39	4311M654	Mark, TOSHIBA Carrier	1

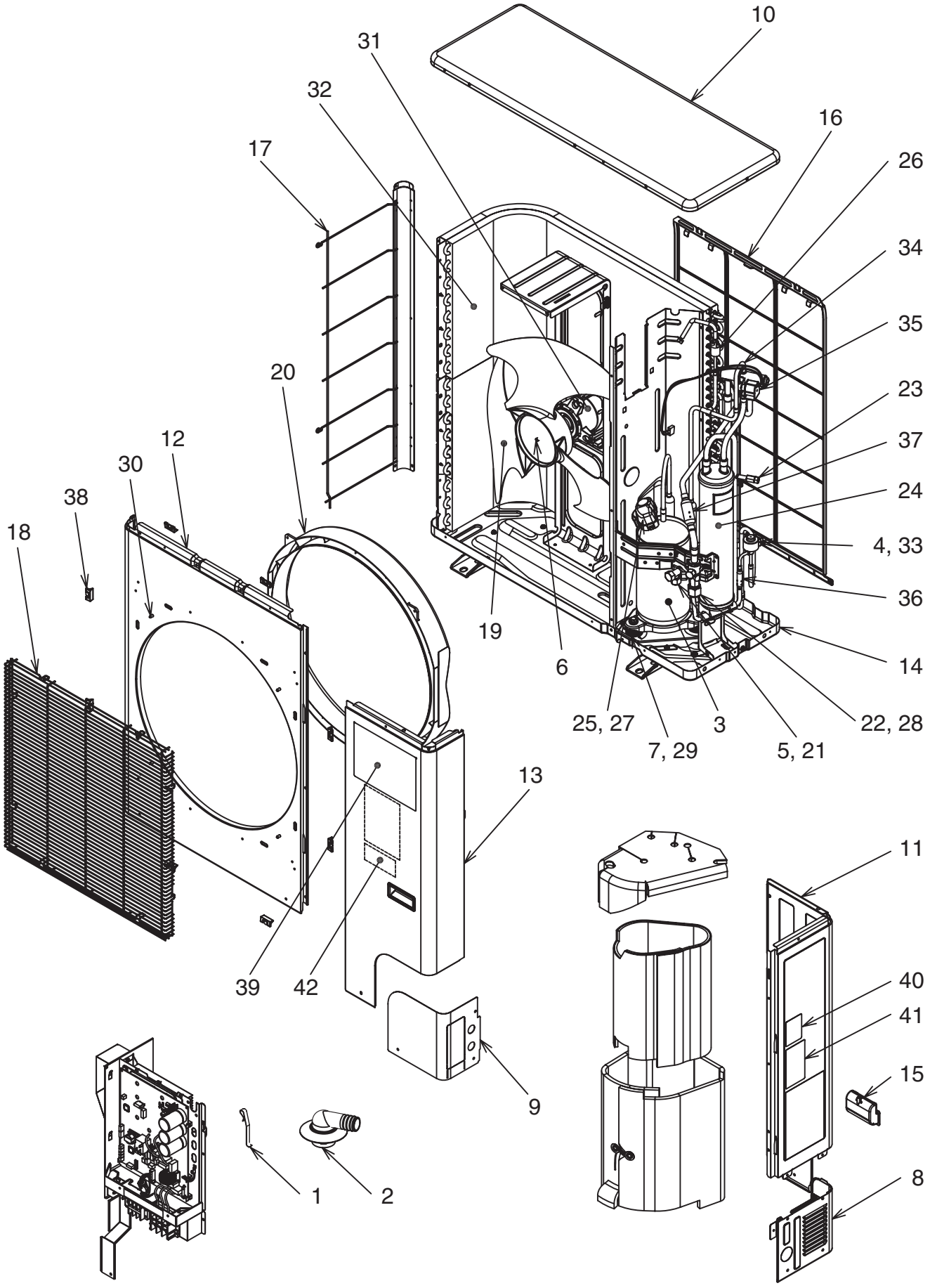
<Inverter assembly>





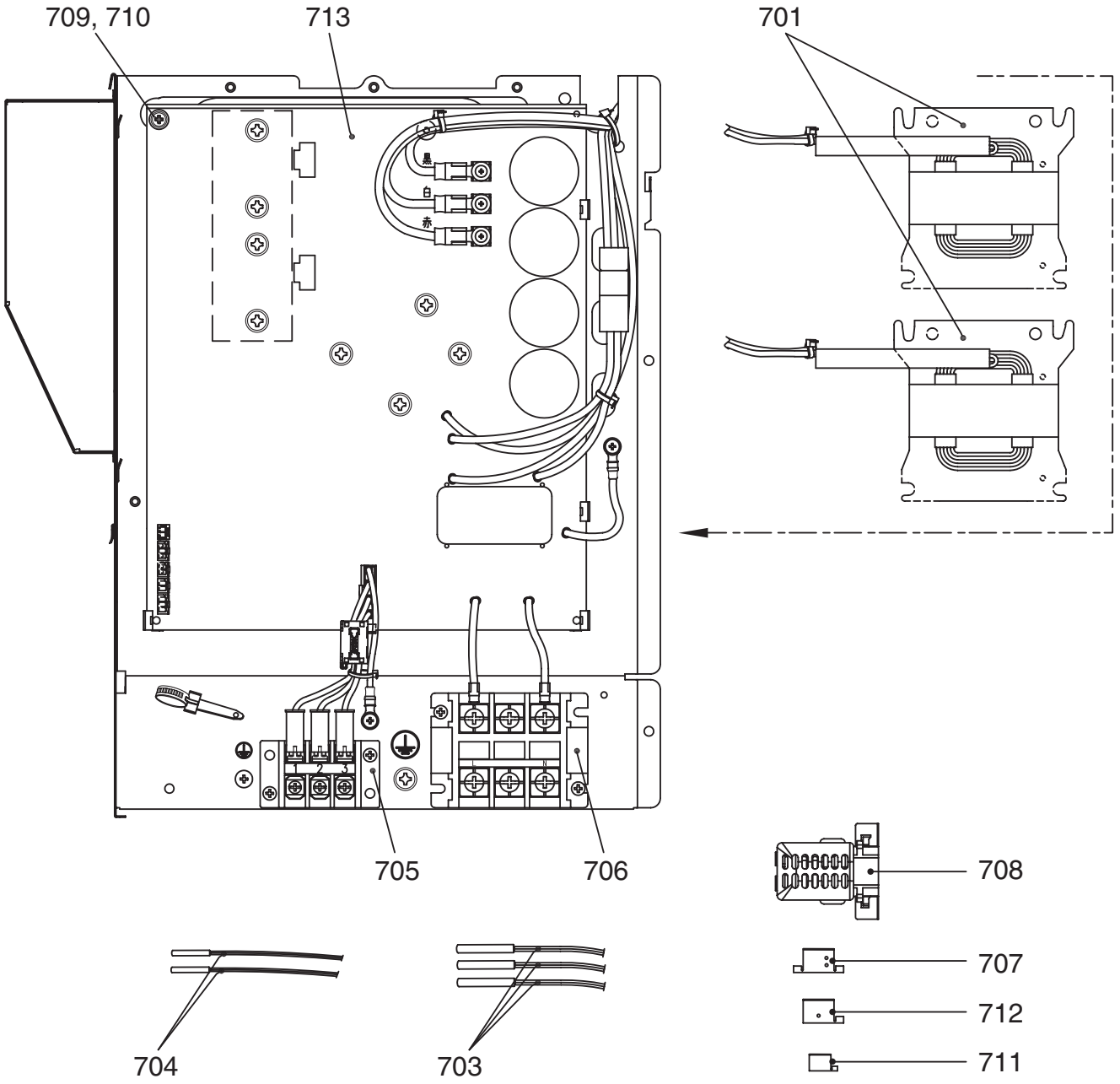
Location No.	Part No.	Description	Model Name
			RAV-SP180AT2-UL
701	43050422	Sensor, TE	1
702	43050423	Sensor, TS	1
703	43050427	Sensor, TO	1
704	43050430	Sensor, TD	1
705	43162058	Base, P.C.board	1
706	43160608	Terminal block, 6P, 20A, AC250V	1
707	43158192	Reactor, CH-43-Z-T, RoHs	1
708	4316V293	P.C. board Ass'y, SW, MCC-1530	1
709	4316V412	P.C. board Ass'y, MCC-5009	1

12-1-2. RAV-SP240AT2-UL



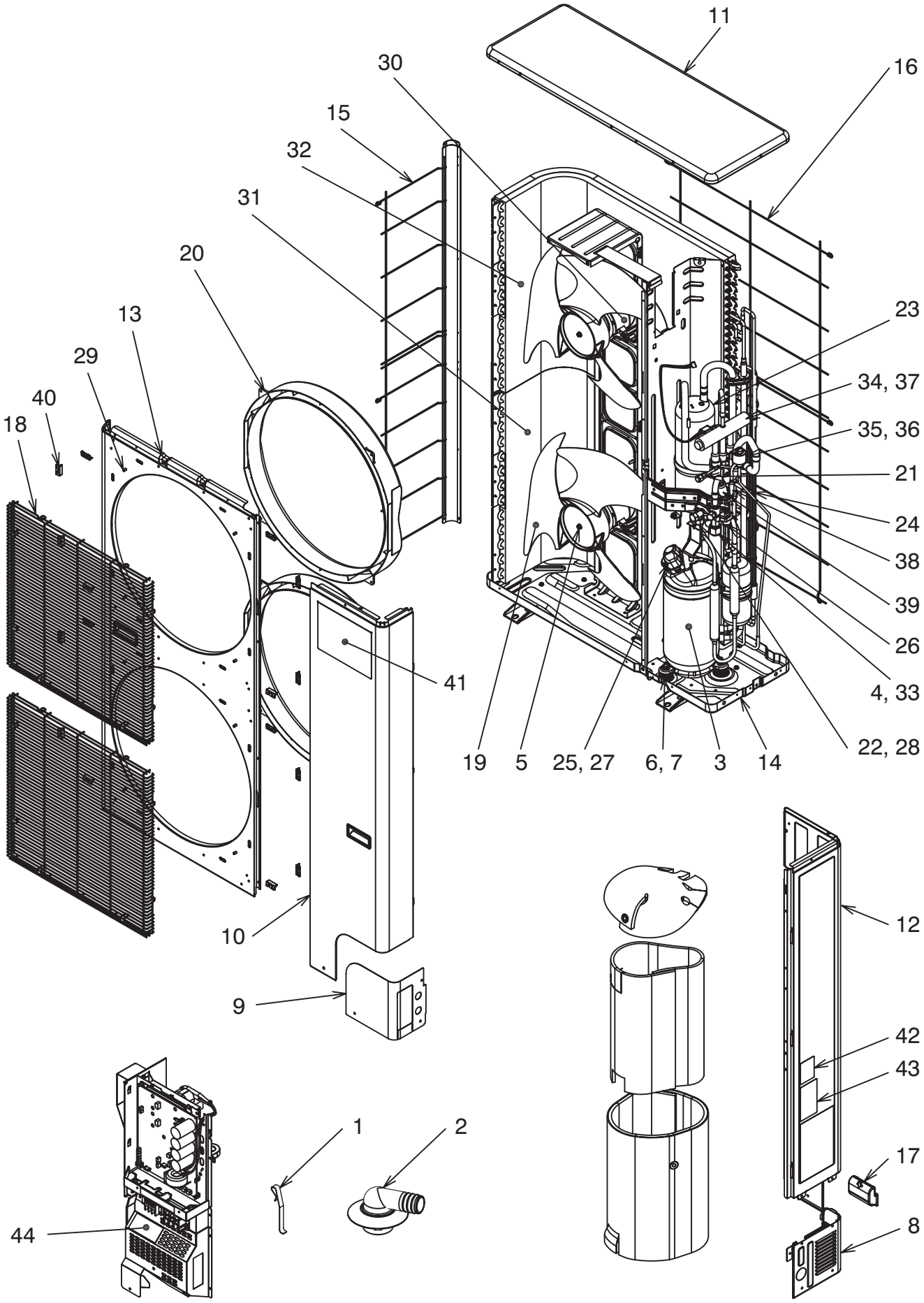
Location No.	Part No.	Description	Model Name
			RAV-SP240AT2-UL
1	43019904	Holder, Sensor	1
2	43032441	Nipple, Drain	1
3	43041798	Compressor, DA220A2F-22L	1
4	43046493	Coil, PMV, CAM-MD12TF-15	1
5	43047246	Bonnet, 3/8 IN	1
6	43047669	Nut, Flange	1
7	43049739	Cushion, Rubber	3
8	43100438	Panel, Back, Piping	1
9	43100459	Plate, Front, Piping Ass'y	1
10	43100440	Plate, Roof	1
11	43100452	Panel, Side	1
12	43100453	Panel, Air outlet	1
13	43100461	Panel, Front	1
14	43100455	Base Ass'y	1
15	43107276	Hanger	2
16	43107277	Guard, Fin, Back	1
17	43107278	Guard, Fin, Side	1
18	43109501	Guard, Fan	1
19	43120224	Fan, Propeller, PB521	1
20	43122113	Bell Mouth	1
21	43146686	Valve, Packed, 9.52	1
22	4314N031	Valve, Ball, SBV-JA5GTC-2, RoHs	1
23	43148220	Plug, Fusible	1
24	43148232	Accumulator, Ass'y, 1.8L	1
25	43150338	Compressor, Thermostat Ass'y, US-622KXTMQO-SS	1
26	43151303	Switch, Pressure Ass'y, ACB-4UB82W	1
27	43160591	Lead Ass'y, Compressor	1
28	43194029	Bonnet	1
29	43197183	Bolt, Compressor, M6	3
30	4301V075	Cover, Screw	4
31	4312C061	Motor, Fan, ICF-34UA60-1, DC340V, 60W	1
32	4314G278	Condenser Ass'y	1
33	4314N034	Valve, Pulse, Modulating, CAM-BD18TF-1	1
34	4314N035	Valve, 4-Way, STF-02U18G	1
35	4314N037	Coil, Valve, 4-Way Ass'y, VHV-01AP552B1	1
36	4314Q031	Strainer, DIA 9.52	1
37	4314Q056	Strainer, DIA 25.4	1
38	43107284	Stopper, Guard, Fan	8
39	4311M654	Mark, TOSHIBA Carrier	1
40	4311M655	Lavel, Caution, Refrigerant	1
41	4311M656	Lavel, Warning	1
42	4311M657	Lavel, Caution, Wiring	1

<Inverter assembly>



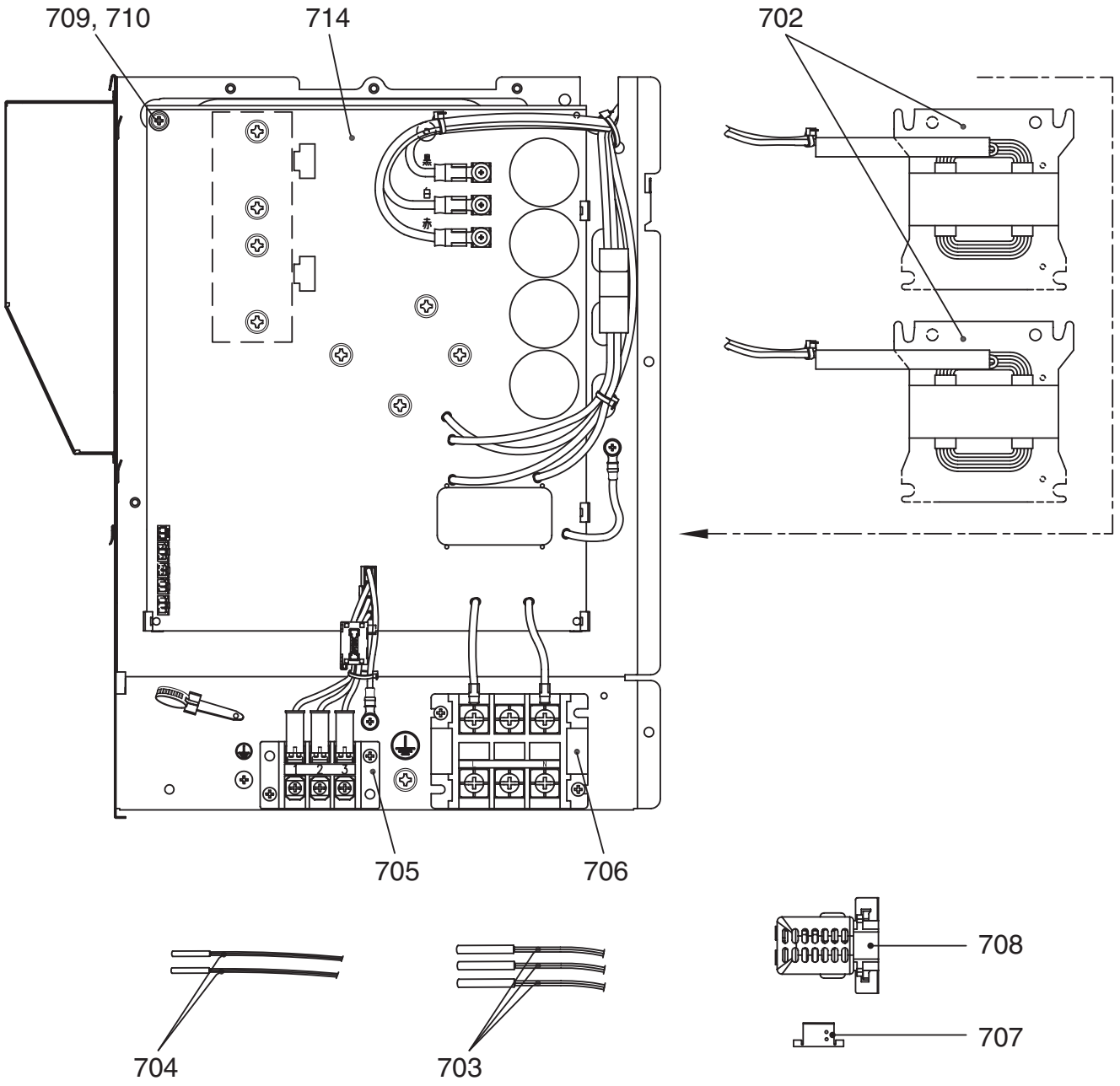
Location No.	Part No.	Description	Model Name
			RAV-SP240AT2-UL
701	43155188	Reactor, CH-56-2Z-T	2
703	43050425	Sensor Ass'y, Service, TC (F6)	3
704	43050319	Sensor Ass'y, Service, TD (F4)	2
705	43160607	Terminal Block, 3P, 20A, AC250V	1
706	43160609	Terminal Block, 3P, 60A, AC600V	1
707	43063325	Holder, Sensor, 6-6.35, 8	1
708	43163055	Holder, Sensor	1
709	43163059	Spacer, Bush	1
710	43163060	Spacer, Collar	1
711	43063321	Holder, Sensor, 4-8, 9.52	1
712	43063322	Holder, Sensor, 6-11.4, 12.7	1
713	4316V402	P.C.board Ass'y, MCC-1571	1

12-1-3. RAV-SP300AT2-UL, RAV-SP360AT2-UL, RAV-SP420AT2-UL



Location No.	Part No.	Description	Model Name RAV-		
			SP240AT2-UL	SP360AT2-UL	SP420AT2-UL
1	43019904	Holder, Sensor	3	3	3
2	43032441	Nipple, Drain	1	1	1
3	43041794	Compressor, DA422A3F-25M	1	1	1
4	43047246	Bonnet, 3/8 IN	1	1	1
5	43047669	Nut, Flange	2	2	2
6	43049739	Cushion, Rubber	3	3	3
7	43097212	Nut	3	3	3
8	43100438	Panel, Back, Piping	1	1	1
9	43100459	Panel, Front, Piping Ass'y	1	1	1
10	43100460	Panel, Front	1	1	1
11	43100440	Plate, Roof	1	1	1
12	43100441	Panel, Side	1	1	1
13	43100442	Panel, Air Outlet	1	1	1
14	43100443	Base Ass'y	1	1	1
15	43107274	Guard, Fin, Side	1	1	1
16	43107275	Guard, Fin, Back	1	1	1
17	43107276	Hanger	3	3	3
18	43119501	Guard, Fan	2	2	2
19	43120244	Fan, Propeller, PB521	2	2	2
20	43122113	Bell Mouth	2	2	2
21	43146676	Joint, Check	1	1	1
22	43146686	Valve, Packed, 9.52	1	1	1
23	43148170	Accumulator Ass'y, 2.5L	1	1	1
24	43148220	Plug, Fusible	1	1	1
25	43150339	Compressor, Thermostat Ass'y, US-622KXTMQO-SS	1	1	1
26	43151303	Switch, Pressure Ass'y, ACB-4UB82W	1	1	1
27	43160591	Lead Ass'y, Compressor	1	1	1
28	43194029	Bonnet	1	1	1
29	4301V075	Cover, Screw	8	8	8
30	4312C062	Motor, Fan, ICF-340UA100-1, DC340V, 100W	2	2	2
31	4314G266	Condenser Ass'y, Down	1	1	1
32	4314G269	Condenser Ass'y, Up	1	1	1
33	4314N031	Valve, Ball, SBV-JA5GTC-2, Rohs	1	1	1
34	4314N032	Valve, 4-Way, STF-04U1G	1	1	1
35	4314N033	Valve, Pulse, Modulaing, UKV-25D129	1	1	1
36	4314N036	Coil, PMV, UKV-A120U	1	1	1
37	4314N037	Coil, Valve, 4-Way Ass'y, VHV-01AP552B1	1	1	1
38	4314Q031	Strainer, DIA 9.52	1	1	1
39	4314Q032	Strainer	1	1	1
40	43107284	Stopper, Guard, Fan	16	16	16
41	4311M654	Mark, TOSHIBA Carrier	1	1	1
42	4311M655	Lavel, Caution, Refrigerant	1	1	1
43	4311M656	Lavel, Warning	1	1	1
44	4311M657	Lavel, Caution, Wiring	1	1	1

<Inverter assembly>



Location No.	Part No.	Description	Model Name RAV-		
			SP240AT2-UL	SP360AT2-UL	SP420AT2-UL
702	43158190	Reactor, CH-62-ZT	2	2	2
703	43050425	Sensor Ass'y, Service, TC (F6)	3	3	3
704	43050319	Sensor Ass'y, Service, TD (F4)	2	2	2
705	43160607	Terminal Block, 3P, 20A, AC250V	1	1	1
706	43160609	Terminal Block, 3P, 60A, AC600V	1	1	1
707	43063325	Holder, Sensor, 6-6.35, 8	1	1	1
708	43163055	Holder, Sensor	1	1	1
709	43163059	Spacer, Bush	1	1	1
710	43163060	Spacer, Collar	1	1	1
714	4316V403	P.C.board Ass'y, MCC-1571	1	1	1

WARNINGS ON REFRIGERANT LEAKAGE

Check of Concentration Limit

The room in which the air conditioner is to be installed requires a design that in the event of refrigerant gas leaking out, its concentration will not exceed a set limit.

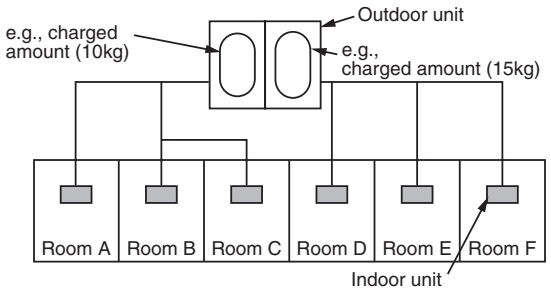
The refrigerant R410A which is used in the air conditioner is safe, without the toxicity or combustibility of ammonia, and is not restricted by laws to be imposed which protect the ozone layer. However, since it contains more than air, it poses the risk of suffocation if its concentration should rise excessively. Suffocation from leakage of R410A is almost non-existent. With the recent increase in the number of high concentration buildings, however, the installation of multi air conditioner systems is on the increase because of the need for effective use of floor space, individual control, energy conservation by curtailing heat and carrying power etc.
Most importantly, the multi air conditioner system is able to replenish a large amount of refrigerant compared with conventional individual air conditioners. If a single unit of the multi conditioner system is to be installed in a small room, select a suitable model and installation procedure so that if the refrigerant accidentally leaks out, its concentration does not reach the limit (and in the event of an emergency, measures can be made before injury can occur).
In a room where the concentration may exceed the limit, create an opening with adjacent rooms, or install mechanical ventilation combined with a gas leak detection device.
The concentration is as given below.

$$\frac{\text{Total amount of refrigerant (kg)}}{\text{Min. volume of the indoor unit installed room (m}^3\text{)}} \leq \text{Concentration limit (kg/m}^3\text{)}$$

The concentration limit of R410A which is used in multi air conditioners is 0.3kg/m³.

NOTE 1 :

If there are 2 or more refrigerating systems in a single refrigerating device, the amounts of refrigerant should be as charged in each independent device.



For the amount of charge in this example:

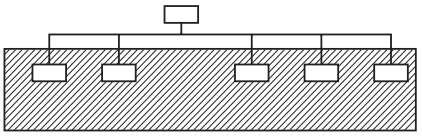
The possible amount of leaked refrigerant gas in rooms A, B and C is 10kg.
The possible amount of leaked refrigerant gas in rooms D, E and F is 15kg.

Important

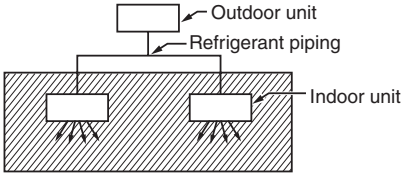
NOTE 2 :

The standards for minimum room volume are as follows.

1) No partition (shaded portion)

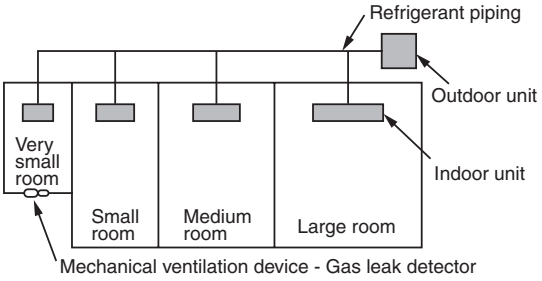


2) When there is an effective opening with the adjacent room for ventilation of leaking refrigerant gas (opening without a door, or an opening 0.15% or larger than the respective floor spaces at the top or bottom of the door).



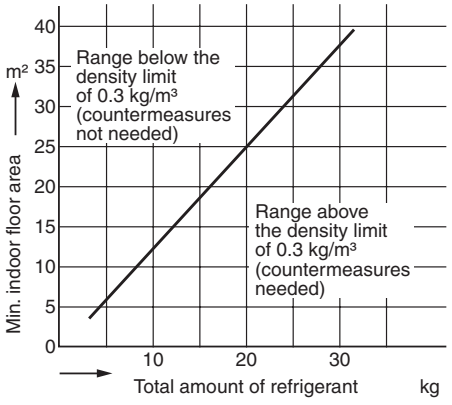
3) If an indoor unit is installed in each partitioned room and the refrigerant piping is interconnected, the smallest room of course becomes the object.

But when a mechanical ventilation is installed interlocked with a gas leakage detector in the smallest room where the density limit is exceeded, the volume of the next smallest room becomes the object.



NOTE 3 :

The minimum indoor floor area compared with the amount of refrigerant is roughly as follows:
(When the ceiling is 2.7m high)



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